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AUTHOR Brophy, Jere; Alleman, Janet; O'Mahony, Carolyn
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ABSTRACT

The traditional K-3 social studies curriculum has focused on food, clothing, shelter, communication, transportation, and other cultural universals, but little information exists about children's prior knowledge and thinking (including misconceptions) about these topics. This study was designed to provide such information with respect to the topic of food, and in the process assess claims that primary-grade students do not need instruction in the topic because they learn what they need to know about it through everyday living. Individual interviews were conducted with 96 K-3 students, stratified according to grade level, achievement level, and gender. Students were asked many diverse questions about the nature of food. Their responses to this food interview displayed many of the same patterns seen earlier in responses to shelter and clothing interviews. They knew more about the physical appearances of things than their underlying natures and more about the uses of finished products than about the land-to-hand transformations involved in creating those products. Response sophistication was related much more closely to age (grade level) and personal experiences out of school than to achievement level or gender. Findings suggest that children do not routinely acquire all, or even a significant portion, of what is worth knowing about cultural universals through everyday experiences. An appropriate balance among the three traditional sources of curricula is called for in K-3, and students stand to benefit considerably from more powerful treatments of cultural universals than those typically offered by textbook series. (Contains a table and 56 references. The "food interview" is appended.) (BT)

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PRIMARY-GRADE STUDENTS' KNOWLEDGE AND THINKING ABOUT FOOD AS A CULTURAL UNIVERSAL

Jere Brophy, Janet Alleman, and Carolyn O'Mahony

Michigan State University

SO 032 651

Jere Brophy

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Abstract

The traditional K-3 social studies curriculum has focused on food, clothing, shelter, communication, transportation, and other cultural universals. Very little information exists about children's prior knowledge and thinking (including misconceptions) about these topics. The study was designed to provide such information with respect to the topic of food, and in the process assess claims that primary-grade students do not need instruction in the topic because they learn what they need to know about it through everyday living. Individual interviews were conducted with 96 K-3 students, stratified according to grade level, achievement level, and gender. The students were asked to define the nature of food and distinguish food from nonfood, explain why people need food, discuss food groups and explain why some foods are healthful and some are junk foods, compare the foods that Americans typically eat today with the foods they ate around 1920, compare foods typically eaten in the United States with foods typically eaten in other parts of the world and explain the reasons for the contrasts in diets, identify foods brought to America from elsewhere, explain why some foods are cooked and others are refrigerated, explain why foods last longer in cans and bottles, describe the land-to-hand progressions involved in bringing several common foods to our tables, identify the products derived from common farm animals, explain why a pound of cereal costs more than a pound of apples and a restaurant meal costs more than the same meal eaten at home, describe the steps involved in growing corn, explain why there are few farms in Alaska, identify inventions that have modernized farming, and explain why many fewer farmers per capita are needed today than in the past. The students' responses to this food interview displayed many of the same patterns seen earlier in responses to shelter and clothing interviews: They knew more about the physical appearances of things than their underlying

natures, and more about the uses of finished products than about the land-to-hand transformations involved in creating those products. Response sophistication was related much more closely to age (grade level) and personal experiences out of school than to achievement level or gender. The findings are discussed with emphasis on their implications for curriculum and instruction in early elementary social studies.

Anthropologists and other social scientists often refer to cultural universals (sometimes called "social universals" or "basic categories of human social experience") as useful dimensions for understanding a given society or making comparisons across societies (Banks, 1990; Brown, 1991). Cultural universals are domains of human experience that have existed in all cultures, past and present. They include activities related to meeting the basic needs of food, clothing, and shelter, as well as family structures, government, communication, transportation, money or other forms of economic exchange, religion, occupations, recreation, and perhaps others as well. The term implies that activities relating to each cultural universal can be identified in all societies, but not that these activities necessarily have the same form or meaning in each society. On the contrary, it recognizes variations among societies (as well as among individuals within societies) in orientation toward or handling of common life events associated with each cultural universal (e.g., family structures are universal, but different cultures and individuals within cultures have different notions of what constitutes a family).

Cultural universals have special importance for early elementary social studies because much of the basic content taught in the primary grades focuses on them. The traditional reasoning has been that teaching students about how their own and other societies have addressed the human purposes associated with cultural universals is an effective way to establish an initial, predisciplinary knowledge base in social studies, preparing the way for the more discipline-based courses of the middle and upper grades. Two major reasons are cited commonly by supporters of the argument that organizing early social studies around cultural universals provides a sound basis for developing fundamental understandings about the human condition. First, human activities relating to cultural universals account for a considerable proportion of everyday living and are the focus of much of human social organization and

communal activity, so instructional units on cultural universals provide many natural starting points for developing initial social understandings. Until they understand the motivations and cause-and-effect explanations that underlie these activities, children do not understand much of what is happening around them all the time. As they develop such understanding, previously mysterious behavior of their parents and other people significant in their lives becomes comprehensible to them, and they become equipped with intellectual tools that will enable them to begin to develop efficacy in these domains themselves.

Second, children from all social backgrounds begin accumulating direct personal experiences with most cultural universals right from birth, and they can draw on these experiences as they construct understandings of social education concepts and pri iples in the early grades. If cultural universals are taught with appropriate focus on powerful ideas and their potential life applications, all students should be able to construct basic sets of connected understandings about how our social system works (with respect to each cultural universal), how and why it got to be that way over time, how and why related practices vary across locations and cultures, and what all of this might mean for personal, social, and civic decision making.

Not everyone agrees with this rationale, or even with the notion of social studies as a pre- or pandisciplinary school subject organized primarily as preparation for citizenship. Some people advocate basing school curricula directly on the academic disciplines. They would offer separate courses in history, geography, and the social sciences, simplified as needed but designed primarily to pursue disciplinary goals rather than citizenship education goals. With particular reference to the primary grades, Egan (1988), Ravitch (1987) and others have advocated replacing topical teaching about cultural universals with a heavy focus on

chronological history and related children's literature (not only historical fiction but myths and folk tales). We agree that K-3 students can and should learn certain aspects of history, but we also believe that these students need a balanced and integrated social education curriculum that includes sufficient attention to powerful ideas drawn from geography and the various social sciences, subsumed within citizenship education purposes and goals. Furthermore, we see little social education value in replacing reality-based social studies with myths and folklore likely to create misconceptions, especially during the primary years when children are struggling to determine what is real and enduring (vs. false/fictional or transitory/accidental) in their physical and social worlds.

Some of those who are opposed to a focus on cultural universals in early social studies have asserted, without presenting evidence, that there is no need to teach this content. Ravitch (1987) dismissed it as "tot sociology," arguing that it holds little interest or value for students, partly because they already know it from everyday experience. Larkins, Hawkins, and Gilmore (1987) also suggested that primary students already know most of this content, so there is no need to teach it in school. The authors of this report have disputed these arguments, suggesting that the knowledge about cultural universals that children develop through everyday experience tends to be tacit rather than well-articulated. Furthermore, much of it is confined to knowledge about how things are without accompanying understandings about how and why they got to be that way, how and why they vary across cultures, or the mechanisms through which they accomplish human purposes (Brophy & Alleman, 1996).

Recent developments in research on teaching suggest the need for data that speak to this issue. Increasingly, theory and research have been emphasizing the importance of teaching school subjects for understanding, appreciation, and life application, using methods that

connect with students' prior experience and engage them in actively constructing new knowledge and correcting existing misconceptions. In mathematics and science, rich literatures have developed describing what children typically know (or think they know) about the content taught at their grade levels. This information informs the design of curriculum and instruction that both builds on students' existing valid knowledge and addresses their misconceptions.

There is potential for applying similar methods in social studies if more is learned about children's ideas about topics commonly taught at school. So far, little such information exists about topics addressed in K-3 social studies. Child development researchers have concentrated on cognitive structures and strategies that children acquire through general life experiences rather than on their developing understanding of knowledge domains learned primarily at school. Research in the Piagetian tradition has focused on mathematical and scientific knowledge, although there have been some studies of stages in the development of economic, political, and social knowledge (Berti & Bombi, 1988; Furnham & Stacey, 1991; Furth, 1980; Moore, Lare, & Wagner, 1985).

Nor have scholars concerned with curriculum and instruction developed much of this kind of information. There have been occasional surveys of knowledge about particular social studies topics (Guzzetta, 1969; Ravitch & Finn, 1987; U.S. Office of Education, 1995a, b). However, these have concentrated mostly on isolated facts such as names, places, or definitions, with reporting of findings limited to percentages of students able to answer each item correctly. To be more useful to educators, the research needs to emphasize questions that probe children's understanding of connected networks of knowledge and analyses that focus on qualitative aspects of their thinking about the topic, including identification of commonly held misconceptions.

Significant progress has been made in studying children's developing knowledge of politics and government. For example, children are much more aware of the administrative than the legislative or judicial aspects of government and they tend to view presidents as godlike figures notable for their power to get things done and their benevolence or caring about the needs of each individual citizen (Connell, 1971; Greenstein, 1969; Hess & Torney, 1967; Moore, Lare, & Wagner, 1985; Stevens, 1982). Research on economics knowledge has begun to uncover stages in children's development of understanding of, as well as common misconceptions in their ideas about, such topics as the functions of banks and the operations of retail stores (Berti & Bombi, 1988; Berti & Monaci, 1998; Byrnes, 1996; Jahoda, 1984; Schug, 1991).

Several teams of investigators have studied children's historical learning (Barton & Levstik, 1996; Brophy & VanSledright, 1997; McKeown & Beck, 1994). This work has demonstrated, for example, that much of the historical knowledge of fifth graders is organized in narrative form, so that it tends to feature stories focused around a few hero figures rather than less personalized causal analyses of historical trends. The students' narratives also tend to compress time and space by depicting face-to-face interactions between people whose life spans did not overlap (e.g., Columbus and the Pilgrims).

Very little information is available concerning children's knowledge and misconceptions relating to the cultural universals emphasized in K-3 social studies curricula. As a first step toward developing such information, we interviewed middle-class students late in the spring of second grade on various aspects of the topic of shelter (before and after they experienced an instructional unit on the topic). Shelter is not only a cultural universal but a basic need, and all of the students had had experience with it throughout their lives. Thus, if

Ravitch and others had been correct in their assertion that children develop clear knowledge about such topics through everyday experience, we should have seen such knowledge demonstrated by middle-class children who were nearing the upper end of the primary-grade range. Instead, we found that the students' prior knowledge about topics relating to shelter was limited and spotty, tacit rather than well-articulated, comprised of loose collections of observations rather than well-integrated knowledge networks that included awareness of connections and understanding of cause-effect relationships, and often distorted by inaccurate assumptions or outright misconceptions (Brophy & Alleman, 1997).

These findings motivated us to launch a series of studies on developments across Grades K-3 in students' knowledge and thinking about cultural universals. Our intention is to generate findings that will have immediate value to social educators interested in developing more powerful curriculum and instruction for the early grades and teaching in ways that connect with students' prior knowledge. We also expect the findings to be of interest to scholars who study developments in children's general cognition or domain-specific knowledge.

All of these studies involve interviewing large samples of students stratified according to grade level (K-3), prior achievement level (high, average, low), and gender (boys, girls). In addition, the first two studies (on shelter and clothing) involved stratifying students according to the socioeconomic status (SES) of the populations served by their respective schools (upper middle-class suburban, middle-class suburban, lower middle-class urban). Interview protocols feature questions designed to elicit extended statements of students' thinking about the topic. Responses are coded for the presence of commonly mentioned ideas or response elements, and scores derived from these codes are subjected to quantitative statistical analyses. In addition,

unusual responses or elaborations of common responses that go beyond the basic ideas represented by the coding categories are listed and discussed in the reports. Analyses focus on general levels of knowledge and trends observed across grade levels, but with attention to how these trends interact with prior achievement level and gender. Findings are discussed with emphasis on their potential implications for curriculum and instruction in primary-grade social studies and on what they suggest about more general developments in children's social knowledge and thinking.

The Shelter Study

The first study in this series focused on students' knowledge and thinking about shelter. It replicated the findings of our pilot study and extended them in several respects. Its findings are presented in detail in a technical report (Brophy & Alleman, 1999b) and in journal articles (Brophy & Alleman, 2000, in press), so they are summarized only briefly here. Analyses indicated that responses emphasized description over explanation and form over function. The students recognized differences in the sizes, construction materials, durability, and general quality of the shelter provided by different forms of past and present housing, but they did not understand much about the historical, geographic, or cultural reasons for these contrasting housing styles. In thinking about contemporary housing, they focused on what is visible inside and outside the home but did not show much awareness of what is in between the walls or beneath the building. They knew that shelter is a basic and universal human need, but they were less appreciative of modern homes as controlled environments for comfortable living that cater to a great many of our wants as well as our more basic needs. Most showed only very

limited awareness of the mechanisms through which modern houses are supplied with water, heat, light, and other conveniences.

Although the students displayed knowledge about evolution in forms of housing over time, they did not know much about why particular forms were emphasized by particular groups. There was very little recognition that housing types reflect differences in climate and local availability of construction materials, and little mention of the portability of tipis or the defensive value of pueblos. Most students were not aware that certain tribes were nomadic societies that moved with the buffalo, so they did not appreciate that portability was a crucial quality of tipis. Most were able to make sensible statements about differences between pueblos and longhouses (e.g., in size or construction materials), but few mentioned differences in climate and geography as factors contributing to the differences between these two forms of Native American housing.

The students' responses concerning log cabins and pioneer life were more accurate and less fanciful than their responses concerning Native American homes and cultures. Even so, misconceptions were common (e.g., that the cabins could easily collapse because the logs weren't nailed together). Furthermore, most of the students emphasized the deficiencies of these homes in comparison with contemporary housing rather than appreciating them as inventive adaptations to their time and place.

Concerning shelter in today's world, most students understood that people have to pay for shelter and that most people prefer homes to apartments. If anything, they may have exaggerated the latter preference, which perhaps was to be expected given their ages and the fact that most of them lived in homes located in suburbs that emphasize family living. They said that homes offer more living space, the privacy and independence that come with

ownership, and extras such as patios, decks, and yards. Most had difficulty explaining what is involved in renting apartments and why some people choose to do so.

The students possessed only limited and spotty knowledge of the economics of housing. Only a few understood that renting is a profit-making business or that people can get mortgage loans to allow them to move into a home before they have accumulated its full purchase price. No student ever said anything that indicated knowledge of the build-up of equity, the appreciation of property value, or other concepts relating to investment or economic assets.

The students also displayed limited and spotty knowledge about the utilities supplied to modern homes. Almost all understood that water is piped into the home, but many were vague or incorrect about the sources of this water, did not appreciate that the water is drawn from fresh- rather than salt-water sources and purified before being sent to homes, and did not realize that it arrives at the homes under pressure. Most of the students understood that thermostats are used to adjust heating, but were vague about where the heat comes from or how the system works. Only 13 percent clearly understood that furnaces contain a fire that heats air which is then circulated throughout the house. Students' thinking appeared to progress from believing that a utility company supplies hot air directly and the furnace is merely a storage place, to knowing that heat is generated in the furnace but not knowing how, to knowing that the furnace contains a fire that heats air. A majority of the students knew that electricity is involved in creating light, because they knew that one must throw a switch to allow electricity to enter the bulb. However, they were unable to explain how the arrival of electricity causes the bulb to light up.

Most students understood that we pay for our utilities, although most were unclear or incorrect about whom we pay and for what. Most students in the K-3 range understood that

families (except for those who have their own wells) pay for water that is piped into their homes, according to how much they use. However, most were unclear or incorrect about payment for heat and light. Few students understood that "heat" bills are actually for natural gas consumed in fires that create heat in furnaces or that "light" bills are actually for electricity consumed when light bulbs are activated.

Overall, the findings on shelter supported our claim that K-3 students' knowledge about cultural universals is tacit rather than well articulated, restricted to knowledge of what is in the absence of connected understandings of how and why it got to be that way, and frequently distorted by gaps and misconceptions. We now turn to the presentation of findings from our interviews on clothing.

The Clothing Study

The second of our studies on cultural universals focused on students' knowledge and thinking about clothing. Once again, analyses indicated that students' responses emphasized description over explanation and form over function. Over 90% of the students understood that clothing is a basic need, although a few said that this depends on the climate. In describing the functions of clothing, 72% mentioned protection against cold and 42% mentioned modesty, whereas only 16% mentioned protection against dirt, sun, insects, or other hazards, and only 5% mentioned clothing's decorative functions. Most of the students were able to describe business, work, and play clothes. In general, responses to these initial questions tended to be accurate (as far as they went) and free of misconceptions.

The next questions assessed understanding that cloth is woven from thread and thread is spun from raw material. Most students said that clothing is made from cloth, but only 25%

understood that cloth is woven. Many thought that cloth is a solid (like leather) or is made by pressing raw material (e.g., fluffy cotton) flat. Even fewer students (13%) understood that thread is spun from raw material. The remaining students could not explain, said that it is made by unraveling existing cloth, or guessed that it is a natural material (hair, animal fur, etc.). Thus, although most students understood the basic functions of clothing and were familiar with different types of clothes, most did not understand the basic nature and manufacturing of cloth.

Modest majorities were able to describe the clothing of prehistoric cave dwellers, the Pilgrims or pioneers, and their great-great grandparents, and 56% could describe ways in which today's clothes are improved over clothes from earlier times. However, most of the latter responses focused on aesthetics (today's clothes are more colorful, decorated with pictures or designs, etc.). Few students talked about today's clothes as being more comfortable, better at keeping us warm, lighter or softer, less likely to fall apart, or available in better variety and quantity. Only 25% were able to name one or more inventions that have made clothes better.

When asked how their shirt or dress was made, most students spoke of sewing (already existing) pieces together to form the basic garment and/or adding color, trim, or decorative design. Only 5% spoke of spinning thread or yarn and only 29% spoke of weaving cloth.

When asked where their shirt or dress was made, 29% said that it was made near where it was purchased, and only 27% said that it was made near where raw materials are plentiful. When asked why they would select a particular shirt to purchase, the majority mentioned the shirt's appearance, color, or design/print (along with its fit). Much smaller numbers mentioned the price, the fabric, or other issues (matches current wardrobe, suited to gender, well made, matches current style/fashion, etc.). Answers to these questions were generally sensible and

free of misconceptions, although they reflected greater preoccupation with the shirt's appearance and less concern about its cost or quality than most adults would express.

When asked whether people in other parts of the world dress differently than we do, over 90% of the students said yes but fewer than 25% could give specific examples (e.g., Mexican sombreros, Chinese robes, Indian saris, etc.). Others could only offer explanations based on climate (fewer/lighter clothes in hot climates) or economic development (a few students noted that some people lack access to our variety of clothing and have to make their own clothes). Along with the misconception that clothes are made in or near stores that sell them, the students' ideas about clothing in other parts of the world indicated limited understanding of ways that geography interacts with economics and culture.

Overall, the students displayed more knowledge and fewer misconceptions about clothing than about shelter, probably because clothing is much less complex and incorporates many fewer key understandings. Even so, the students once again were focused more on easily observable forms and functions of the cultural universal than on less obvious cause-effect relationships and explanations. Levels of understanding increased across the K-3 range, but even at third grade, fewer than half of the students understood the fundamental nature of cloth or thread (see Brophy & Alleman, 1999a, for details).

Children's Knowledge and Thinking About Food

Not much research is available on children's thinking about food or what is involved in producing it and bringing it to the table. Rozin (1990) noted that although food occupies a major portion of the time of humans, it has been virtually ignored in developmental research. However, he did locate and review some relevant studies, especially concerning food selection.

He reported that children learn very early to distinguish food from nonfood items, mostly through parents and other socializers warning them not to put certain substances in their mouths. They also learn about appropriate times for eating, and even about appropriate times for eating certain foods. In particular, American preschoolers are already aware that certain foods typically are only eaten at breakfast (Birch, Billman, & Richards, 1984). Children also know which foods are commonly served or mixed together, although as preschoolers many hold the "charmingly simple view" that if they like X and they like Y, then they will like X plus Y, even when X is meat and Y is whipped cream or chocolate (Rozin, Fallon, & Augustoni-Ziskind, 1986).

Coùlson (1990) found that kindergarten children were able to classify pictures of foods into "fruit" and "not fruit" categories accurately except for confusion about orange juice, and were able to classify lettuce, carrots, and most fruits as "good for you" but cookies and cake as "not good for you." However, they did not show good understanding of traditional food categories and displayed varying levels of understanding of digestive and nutritive processes (when asked to explain on an outline of a human figure the path that food follows after it is taken into the body).

Interviews of children aged 5-12 by Turner (1997) also showed that even five-year-olds have some comprehension of the relationship between food and health. They were generally accurate in distinguishing healthy from unhealthy foods, and many were aware that what they regarded as unhealthy foods were also the ones that they liked eating. However, the children also held various misconceptions about food, especially about its functions and the significance of particular nutrients.

Wellman and Johnson (1982) asked children in kindergarten, third grade, and sixth grade to judge the causes of certain end states (e.g., why X is fat) and the results of certain contrasting diets (e.g., Twin 1 eats twice as much candy as Twin 2). They found fairly sophisticated knowledge of relationships between different kinds of food and accumulation of fat in the body, although kindergarteners often revealed systematic misconceptions. Fishman, Pearson, and Reicks (1999) reported findings indicating that good knowledge of healthful vs. unhealthful foods is not universal in young children. Their interviews of 9-12-year-old children of migrant farm workers indicated that most had difficulty describing a healthy person and few made connections between diet and health. They concluded that nutrition knowledge was lacking among these children, especially as it related to intake of fat and sugar. There is reason for concern about making sure that all children learn about relationships between diet and health, because food is one of the two largest categories of television advertising targeted at children (the other is toys), and the majority of these ads are for sugared cereals, candy bars, salty canned foods, fast food, and other "junk food" (Horgen, Choate, & Brownell, 2001).

Driver, Squires, Rushworth, & Wood-Robinson (1994) reported that young children appear to consider anything useful taken into the body to be food, including water and minerals. From an early age, they link eating with consequences that include growth, health, strength, and energy, but their knowledge tends to be vague and spotty. They tend to give non-functional explanations of the importance of food, saying that it is needed to keep us alive but not referring to its role in metabolism. Even 13- and 14-year-olds do not think of food as material that serves as a substrate for respiration.

Preschool children tend to think that consumption of anything, including water, will lead to gains in body weight and that there are direct relationships between amounts of food

consumed and gains in height as well as girth. Driver and her colleagues listed age 8 as the time at which most children differentiate different kinds of diet as making people fat or strong. Kindergarten children are likely to know that fruits and milk are good for them but not to know why, as well as to know about vitamins as "pills to make people strong and healthy" but not to realize that ordinary food contains vitamins.

Utset, Villanueva, and Gonzalo (1998) assessed the prior knowledge of 11-year-old students before teaching a module on food. They found that these students were more knowledgeable about the origins of foods derived from animals than foods derived from plants and that they verbalized health concerns about food products which they identified as "industrial" (potato chips, soup, and other processed foods) and about candy, soda pop, and other high-sugar foods.

Michela and Contento (1984) asked children aged 5 to 11 to place 71 foods into groups and explain their criteria. They found that all of the children formed a sweets group, 50% a fruits group, 50% a vegetable group (only 25% combined fruits and vegetables), 48% a drinks group, 24% a dairy group, and 20% a breads and grains group. This pattern differs in several respects from the Basic Four food groups generally taught in nutrition education (proteins, dairy, fruits and vegetables, and grains). Children tend to use obvious differences in appearance as their basis for classifying foods, whereas nutrition educators classify largely on the basis of the foods' nutrient compositions.

Most children do not know much about nutrition or how the body processes foods. Several studies have shown that children do not understand that food is processed by the human digestive system to extract needed nutrients. Contento (1981) interviewed children aged 5 to 11 and found that the youngest viewed foods as unchanged in the body. Slightly

older children viewed foods as undergoing some changes in physical form (e.g., decomposition into smaller particles), but only a few of the 10- and 11-year-olds demonstrated an understanding that food exerts its effects on the body through its components (nutrients). Nagy (1953) and Gellert (1962) reported similar beliefs about the fate and effect of food in the body among children of the same age group. Contento also found that younger children had difficulty understanding that familiar terms such as "sugar" or "vitamins" were components of food (they understood them only as foods in their own right).

Along with food groups comparable to the Basic Four classification, Michela and Contento (1984) found that children often used qualitatively different kinds of groupings: functional categories (breakfast/lunch/dinner/snack foods), nutritional qualities (junk/bad/cavity foods vs. nutritious/good/healthy foods), and distinctions in taste or texture (sweet or sugary, crunchy or crisp, soft, etc.). A few also came up with idiosyncratic categories such as foods that need to be refrigerated, foods that are salty, or foods to eat when it is cold outside. Dimensional analyses of the children's groupings and explanations indicated common tendencies to distinguish sweet from nonsweet foods, meal entrees from more versatile foods and drinks, whole/fresh/less processed foods from cooked/more processed foods, and animal-origin from plant-origin foods.

The children were probed for their understanding of the terms "proteins," "vitamins," "carbohydrates," and "fats." Levels of understanding varied with level of cognitive development (preoperational, early concrete operational, or late concrete operational, as determined by performance on Piatgetian tasks). The children had the most knowledge about vitamins and the least about carbohydrates, although their descriptions reflected only very simple understandings of nutrients. Proteins and vitamins were described as "good for you"

and often confused with each other, even by older children. Many thought that vitamins are found only in pills. The children generally viewed fats as bad for you, with only a few understanding that fats are reserve energy or are needed by the body. Very few children knew much about carbohydrates. Those who did thought that they were needed by the body but associated them with sugar and thus considered them bad for you. Some reported seeing the word on cereal boxes or hearing it spoken by parents but not knowing what it meant. In discussing their study, Michela and Contento concluded with some interesting suggestions about matching nutrition education to children's developmental levels (e.g., sweetness is salient to even the youngest children, so early nutrition education might focus on avoiding too much sugar, whereas information relating to distinctions between animal-derived and plant-derived foods or between minimally and highly processed foods might be withheld until children become more conscious of these dimensions).

Most of what is known about children's thinking about food concerns their knowledge of its nutritional properties. We were unable to locate many studies of knowledge about food production, geographic or cultural influences on diets, or other societal aspects of the topic.

Mugge (1963) found that urban second graders were able to report only limited and imprecise information about farming, even though they had studied the farm in first grade. She attributed this to the children's lack of direct experience with farms.

Barrett and Short (1992) studied English school children's images of people from other European countries. They found that the younger children (ages 5-7) had limited factual knowledge about these countries but nevertheless did have some idea of their diets. For example, they associated the French with snails, garlic, and French bread and the Italians with spaghetti, pasta, seafood, and pizza.

Our Food Interviews

We developed an interview protocol designed to elicit students' thinking about what we consider to be key ideas that ought to be emphasized in an elementary social studies curriculum that treats food as a cultural universal. The content base for the interview was synthesized from three general sources: (1) social studies education textbooks and other sources that identified key ideas about food that are rooted in the social science disciplines; (2) information about food typically included in elementary social studies textbook series or in children's tradebooks on the topic; and (3) our own ideas about the key features of elementary social studies units that focus on cultural universals and are designed to teach the material for understanding, appreciation, and life application (Brophy & Alleman, 1996). We believe that the most basic and important ideas for children to learn about food include: food as a universal need; the nature of food and how it differs from things that are not food; food groups; developments in food availability and consumption patterns over the last century; the nature of and reasons for differences between the United States and other countries in commonly eaten foods; why some foods are eaten raw but others are cooked; why some foods are refrigerated; how people preserved foods prior to refrigeration; why bottling or canning preserves foods; why certain foods are good for us and others are not; origins and phases of transformation or processing involved in bringing various common foods to our tables; the products derived from animals commonly raised on farms and ranches; basic steps involved in growing corn; why more highly processed foods tend to be more expensive than less processed foods; why the same meal is more expensive in a restaurant than at home; how climate and geography affect farming; how farming processes and tools have developed over the last century; and why farming has become so efficient that only a small proportion of the population now is able to

produce all of the food that the nation needs. Taken together, the interview questions assessed knowledge not only about food as such but about historical, geographic, social, and economic aspects of food production, distribution, and consumption.

After identifying and sequencing the content base to be addressed, we developed and revised initial drafts of the interview protocol. These drafts featured primarily open-ended questions, typically followed by planned probes, designed to elicit extended statements of students' knowledge and thinking about the topic. Probes were designed to reveal whether students understood and could explain the concepts or relationships addressed by the initial questions (and if not, what alternative concepts or relationships they might have constructed).

The "funnel" interview technique was used, in which initial broad questions encourage students to make extended statements about a topic, attending to whatever aspects of the topic they select for focus on their own initiative, and explaining themselves in their own words. Probing then begins with follow-up questions asking (if necessary) for clarification or elaboration of what students have said in their initial statements. Finally, more specific questions are asked (if necessary) to call students' attention to aspects of the topic that they did not address spontaneously. This approach maximizes the degree to which students' responses reflect their own unique stances toward and construction of knowledge about the topic, and it minimizes the cueing of specific responses through suggestive questions. Yet, it also ensures that all of the students address certain key aspects of the topic (either because they do so spontaneously in responding to initial broad questions or because they are asked more specific questions later).

Successive drafts of the interview were piloted with students who were not involved in the later study. This pilot work led to revisions designed to make sure that all questions were

clear, to specify probing and follow-up questions more completely, and to eliminate questions that were too easy or difficult to be useful. This process eventually yielded the final version of the interview shown in Appendix 1.

Sample

Our first two studies (on shelter and clothing) involved interviews with 216 students, 54 in each of Grades K-3, stratified within each grade by the socioeconomic status (SES) level of the community, the students' prior achievement levels, and the students' gender. The SES variation was introduced by conducting one-third of the interviews in an upper-middle class suburban community, one-third in a middle/working-class suburb, and one-third in lower-middle/working class neighborhoods of a small city. Together, these samples subsumed the middle three-fourths or so of the SES range in the general population.

The patterns of findings that appeared in the first two studies led us to discontinue further systematic sampling across the SES range, because the observed SES differences in these studies were relatively small and not especially interesting or informative. Students from higher SES backgrounds tended to have more, or more accurate, knowledge than students from lower SES backgrounds, but the same general developmental patterns were observed in each group. We did not find theoretically or practically interesting group contrasts (e.g., contrasts suggesting the existence of qualitatively different developmental paths or constructions of knowledge that were unique to particular SES groups). Consequently, we concluded that in our future work it would be more efficient to concentrate initial studies at the middle of the SES distribution (by interviewing in the same middle/working class suburb for which the middle SES samples in the first two studies were drawn). Possible group differences would

then be addressed in follow-up studies. For example, we followed up the shelter study by interviewing students who live in Manhattan, a highrise, high-density residence area that contrasts with the lowrise, low-density communities of the Michigan students interviewed in the initial study. Also, given that our food interview includes several questions on farming and the origins of food, we are following up the initial food study described in the present report with interviews of students from farm families.

The students interviewed for this study attended the public schools of a middle/working class bedroom suburb of a small city (population about 160,000). The community is average or slightly above average on most socioeconomic and educational indices. During the years when these interviews were conducted, the community's high school graduation rate was 83% and the percentages of its fourth graders who achieved "satisfactory" scores on the state's achievement tests were 49% percent for reading and 65% for mathematics.

Reflecting their school populations, the majority of the students we interviewed were white. We did not consider race or ethnicity in identifying students for the sample, except for the stipulation that all interviewees must have spent all or at least most of their childhood in the United States. Recent immigrants or students who had spent most of their preschool years in other countries were not included, because an assumption underlying the work was that what the students knew about food (other than what they had been taught at school) had been learned in the process of growing from infancy in the contemporary United States (particularly through home and neighborhood experiences and exposure to television and other media).

Interviewees were selected from among students whose parents gave us permission to do so. Most parents who returned our forms did give such permission, although a significant minority of parents never returned the forms despite repeated requests. Once the potential

interviewees in a given classroom were identified, they were listed alphabetically by gender and the teacher was asked to characterize them, within gender groups, as being within the upper third, the middle third, or the lower third in general academic achievement. When we had access to more students in a given cell (e.g., high achieving male first graders) than we needed, the students to be interviewed were selected randomly from within the eligible group. When additional students were needed to fill out certain cells, we expanded sample recruitment to a nearby school in the same district that served a very similar student population.

Collection and Preparation of Data

Students were interviewed individually. The interviews typically lasted about 30 minutes and were conducted in small offices or other locations within their schools but outside of their classrooms. To facilitate rapport with students and make sure that their responses were preserved verbatim, the interviews were tape recorded, using a microphone that could be placed unobtrusively on the table and did not require either the interviewer or the student to handle it or speak directly into it. Interviewers were instructed to establish good rapport with the student before beginning and then to conduct the interview in a relaxed and conversational style rather than a more formal or test-like style.

The tape recorded interviews were transcribed by one person and then listened to by a second person who identified omissions and inaccuracies in the transcripts. Data for statistical analyses were then developed by coding the corrected transcripts.

Coding the Transcripts

We did not attempt to force students' responses into predetermined coding categories. Instead, we allowed the categories to arise from the data, using what have been called analytic induction methods for developing grounded theory (Bogdan & Biklen, 1982; Glaser & Strauss, 1979; Patton, 1990). Coding schemes were developed by reading responses to each question and identifying common ideas (embodied in similar statements) that represented alternative ways to respond to the question. Responses then were coded for the presence or absence of mention of these common ideas. Multiple codes were assigned if the student mentioned more than one of the ideas. In addition to categories encompassing common ideas, each coding scheme contained an "other" category for flagging rare or unique responses.

After initial versions of the coding schemes were developed and refined, reliability was established between two coders who coded one-fourth of the transcripts (stratified according to grade level, achievement level, and gender). Upon completion of this coding, the two sets of codes were compared and inter-coder agreement percentages were computed. Most coding schemes initially met our criterion of 60% exact agreement across coders. When coding schemes failed to meet the inter-coder agreement criterion, the coders analyzed the problem and made adjustments in the coding schemes, then coded the one-fourth sample of responses again. All of the revised coding schemes met the inter-coder agreement criterion at this point. Across the 37 coding schemes used, exact agreement percentages ranged from 60% to 100%, averaging 81%.

Once the coding schemes had met the reliability criterion and been revised as needed (to incorporate minor alterations or elaborations suggested by insights developed while coding to establish reliability), the two coders used them to code all 96 interviews. Upon completion

of their independent coding, they compared their codes and negotiated agreement on all discrepancies. They also developed a running list of the rare and unique responses that had been coded into the "other" categories, as well as any unusual elaborations of common ideas that seemed worth preserving for possible inclusion in this report. Thus, the report encompasses not only the commonly observed response variations that were amenable to statistical analysis, but also the rare or unique responses and any elaborations on common responses that seemed worth including because they appeared to have theoretical or practical significance.

Once coding was completed, the codes were converted into scores that became the bases for statistical analyses. In most cases the codes were used as is. However, some commonly occurring responses that originally were coded in the "other" category were broken out to create new scores, and some categories that were coded too infrequently to serve as a basis for useful statistical analyses were folded into related categories or simply omitted from such analyses. For example, the following scheme was used to code responses to Question 8, which asked the students to name foods that were brought to America by people who came from other countries.

0. Doesn't know/no relevant response
1. Lists countries or continents (without naming foods)
2. Lists generic or common food items (fruit, meat, milk, etc.)
3. Lists specific crops or foods of the Americas (corn, tomatoes, turkey, peanuts, pumpkins, etc.)
4. Lists specific crops originating from other countries (rice, bananas)

5. Lists specific dishes originating from other countries (spaghetti, goulash, crab Rangoon, tacos, etc.)

6. Identifies both particular people and particular foods they brought (Chinese people brought Chinese food, Pilgrims brought turkeys, etc.)

7. Other: relevant, substantive response not included in previous categories

Inspection of the codes generated using these categories indicated that: (1) only four students had been coded "1" because they mentioned countries or continents but did not name any specific foods, and their responses didn't seem worth separating from those of students coded "0" (who were unable to generate a substantive response); (2) only five students were coded "6" because they identified both the people who brought foods to America and the foods that they brought; and (3) the "7" category was not used. Consequently, in deriving scores from these codes, the original "1" codes were combined with the "0" codes; the "6" codes were combined with the "5" codes (because the students coded "6" had identified specific dishes brought from other countries); and the "7" category was dropped. As a result, the original codes for this question were converted into the following scores used in the analyses:

0. Doesn't know/no relevant response

1. (not used)

2. Lists generic or common food items (fruit, meat, milk, apples, etc.)

3. Lists specific crops or foods of the Americas (corn, tomatoes, turkey, peanuts, pumpkins)

4. Lists specific crops originating in other countries (rice, bananas)

5. Lists specific dishes originating in other countries (spaghetti, goulash, crab Rangoon, tacos, etc.)

6. Is coded either 4 or 5

As exemplified in the last line of the example above, combination scores sometimes were created when low frequencies of their component codes precluded statistical analyses but certain combinations of related codes would be meaningful, or when creating the combination scores allowed analysis of higher-order questions about the topic that could not be addressed directly using the individual component scores. In this instance, adding a "6" code to the scores recorded for students who had been coded either "4" or "5" allowed us to compare students who correctly identified either a crop or a dish (or both) originating in other countries with students who were unable to do so.

Data Analysis, Interpretation, and Presentation

Scores derived from the codes were subjected to statistical analyses designed to reveal trends in the sample as a whole as well as contrasts across subgroups of students who differed in grade level, achievement level, or gender. These analyses included frequency distributions and means reflecting the degree to which various ideas were expressed across the sample as a whole and within its stratified subgroups, correlation coefficients indicating the direction and degree of relationship among the variables, and Chi-Square analyses indicating when subgroup differences were large enough to reach statistical significance.

Initial inspection of the results of these analyses indicated that (1) the response patterns to most questions featured statistically significant and often quite dramatic grade level differences showing increases in level and accuracy of knowledge across the K-3 range, (2) the achievement level differences, and (especially) the gender differences were much smaller and less likely to reach statistical significance, and (3) most of the achievement level differences

that did appear were in the expected direction and thus not especially interesting or informative (that is, students who were higher in prior achievement level tended to have more, or more accurate, knowledge than students who were lower in prior achievement level, but the same general developmental patterns were observed in each group).

Given the uniformity of this pattern (with very minor exceptions that are noted when the relevant data are discussed), we decided to organize the presentation of findings in this report as follows. First, findings from related clusters of questions are presented together. For each question cluster, data presentation begins with discussion of descriptive statistics and the progressions in students' knowledge across Grades K-3, illustrated with excerpts from eight students' interview responses. We then present the findings on achievement level and gender differences. Except where the data indicate otherwise, we treat these group differences as relatively minor variations on the main themes established by the grade level differences.

Next, we turn to the correlational data, reporting noteworthy patterns that appeared in the relationships between the response categories under discussion and the categories used to code responses to other questions in the interview. These relationship patterns help us to interpret the meanings and implications of the various response categories, both in their own right and relative to one another. They are especially helpful when the grade level, achievement level, or gender differences found for a response category seem counterintuitive (if the meaning of the category is taken at face value). Sometimes, the correlational patterns indicate that the responses coded into a category had different meanings or implications (e.g., were either more or less sophisticated) than the category descriptor seemed to imply.

After presenting these quantitative data, we turn to a more holistic analysis of what the findings suggest about developments in children's knowledge and misconceptions about food

as they progress through Grades K-3. Along with the data shown in the tables, these analyses include consideration of the rare and unique responses and unusual elaborations of common responses that were recorded and analyzed for potential significance. Taken together, these findings are discussed with reference to previous findings (where available), the understandings we have developed about growth and change in children's knowledge and misconceptions relating to food, and the potential implications of these understandings for curriculum and instruction in elementary social studies.

Why People Need Food

The first question assessed students' understanding that food is a universal human need:

Question 1. People all over the world eat food. Is that just because they like to or do they need food? . . . Why? . . . What does food do for us?

Over 90% of the students understood that food is a basic need: 90 said that we need food and the other 6 didn't know (none said that we do not need food). More than two-thirds (68) of the students said that we need food to keep us alive. Other common responses were that we need food to be healthy (27), to grow (16), for the energy or fuel that it provides (13), or because it gives us strength or helps our bones, muscles, or other body parts or functions (10).

The following examples are representative of responses to the first question. They are segments drawn from verbatim transcripts of the interviews, although they have been edited to eliminate extraneous material (mostly final probes that failed to elicit any additional response). Here and throughout the rest of the report, the examples are drawn from the transcripts of interviews of eight average achieving students, one boy and one girl from each of grades K-3.

Kindergarten

Jered

They need food to live. (What does it do for us?) It makes us strong.

Kate

They need to. (Why do they need to?) I don' t know.

First Grade

Chris

They need food. (Why do they need food?) So they won't die and it gives them energy to live.

Lauren

They need food. (Why to they need food?) To keep them alive.

Second Grade

Mark

They need food. (Why do they need food?) So they can get protein that helps them and so they can stay alive.

Emily

They need food, because if they don't eat food, they'll die.

Third Grade

Dale

They need food. (Why?) Because they might starve, and they need to keep a healthy body.

Chelsea

They need food to help them grow.

Grade Level Differences

Descriptive statistics and information from the Chi-square analyses of scores derived from the coding of Question 1 (and all of the other questions in the interview) are given in Table 1. The numbers in the columns for the total sample (N = 96), the four grade level groups (N = 24), the three achievement level groups (N = 32), and the two gender groups (N = 48) are simple frequency scores indicating the numbers of students in the sample as a whole and within each grade level, achievement level, or gender group who were coded for mentioning the idea represented by the response category. Sets of scores are underlined if the analyses described below identified statistically significant relationships between the frequency of use of a response category and the students' grade level, achievement level, or gender.

The score distributions were subjected to Chi-square analyses to determine whether the differences observed reached the .05 level of statistical significance. Two forms of Chi-square analysis were used. The first, used with all of the distributions, was a conventional Chi-square analysis that assesses the probability of obtaining the observed group totals if it is assumed that the variable appears with the same frequency in each group within the population as a whole (in other words, if it is assumed that there are no group differences). This Chi-square test does not take into account that the groups might be ordered on a dimension (e.g., grade level or achievement level). Consequently, a statistically significant result simply indicates that the variance in the group totals exceeds that which might be expected to occur because of chance variations in sample characteristics.

A related analysis, the Mantel-Haenszel Chi-square test, was used to assess the statistical significance of trends observed in the grade level and achievement level distributions. These two distributions involved a progressive ordering of their categories (from

kindergarten through third grade, and from low through average to high achievement level). The Mantel-Haenszel statistic takes into account such progressive ordering and tests for directional trends (i.e., tendencies for the scores to either rise or drop as one moves up the grade or achievement levels). Statistically significant Mantel-Haenszel Chi-squares do not imply that the difference between each successive grade level or achievement level score is statistically significant, or even necessarily consistent with the overall trend. However, they do indicate that a statistically significant rising or dropping trend was detected across the four grade levels or the three achievement levels.

In compiling the data for Table 1, we first examined the grade level and achievement level comparisons for the significance of the Mantel-Haenszel Chi-square. If this Chi-square was significant at or below the .05 level, we underlined the group totals and recorded the phi coefficient (comparable to a conventional correlation coefficient) to indicate the direction and level of strength of the relationship between grade level (or achievement level) and the frequencies of coding of the response category in question. If the Mantel-Haenszel Chi-square did not reach the point .05 level of statistical significance, we examined the findings for the conventional Chi-square. Usually this Chi-square also failed to reach significance, in which case we did not underline the group totals or record a phi coefficient in the table. In a few instances, the Mantel-Haenszel Chi-square was not statistically significant but the conventional Chi-square was. This indicated that there was statistically significant variation across the groups being compared, but this variation did not take the form of a systematically rising or dropping trend that paralleled the grade level or achievement level progression. Where these unexpected nonlinear group differences appeared, we underlined the group totals and placed the letters "NL" (standing for nonlinear) in the phi coefficient column. In summary, for the

grade level and achievement level analyses, we (1) underlined the set of group totals and included the phi coefficient when the analyses indicated a significant directional trend, (2) underlined the set of group totals and entered "NL" when the analyses indicated significant nonlinear variance, and (3) did not underline the set of group totals and did not enter either a phi coefficient or the letters "NL" when neither of the Chi-square analyses yielded a significant result.

The Mantel-Haenszel Chi-square test was not appropriate for assessing the statistical significance of gender differences, because the two gender groups (boys, girls) are not ordered on a continuum. Consequently, the conventional Chi-square test was used for this purpose. When this test indicated a statistically significant difference between the two gender groups, the gender totals were underlined and the phi coefficient was entered to indicate the direction and strength of the relationship (negative phi coefficients indicate that the boys were coded significantly more frequently in the category than the girls; positive phi coefficients indicate that the girls were coded significantly more frequently than the boys). When the Chi-square test failed to indicate statistical significance, the gender totals were left without underlining and no phi coefficient was entered. To simplify the table, decimal points were omitted from all of the phi coefficients recorded.

Analysis of the scores derived from the coding of responses to Question 1 indicated that three of the six sets of group totals showed significant relationships to grade level (see Table 1). The first relationship was a negative one, indicating that failures to respond to the question were more common in younger than older students. This same trend appeared for almost all of the questions in all of our interviews. There is considerable variation from question to question in the percentage of students who say "I don't know" or who are unable to provide a

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substantive response that speaks to the question. Whatever their frequency may be, however, these failures to respond to questions tend to be concentrated in the younger students, especially the kindergarteners. In this case, only six students were unable to respond to Question 1. Five of these were kindergarteners and one was a first grader.

The other two significant relationships with grade level were positive ones, indicating that two of the responses were more likely to be made by older than younger students. This included the most popular response (We need food to stay alive/avoid starvation) as well as the statement that food is our source of energy. The latter statement was the only one that approached providing an explanation for what food does for us. It appeared in the responses of only 13 students. Although these students were able to say that food gives us energy, none of them elaborated with anything approaching a scientific explanation of the processes involved. Thus, our findings indicated that the students understood that food is a basic need but confirmed findings of previous research indicating little knowledge of nutrition or the processes through which food exerts its effects on our bodies (Driver et al., 1994).

Achievement Level and Gender Differences

The categories for responses to Question 1 showed one significant relationship with achievement level and one with gender. The achievement level relationship indicated that more high achievers and fewer low achievers said that food provides energy or fuel for the body. This provides more evidence that this response was the most sophisticated of those that appeared frequently enough to constitute a coding category.

The gender difference indicated that 39 boys but only 29 girls said that we eat food to stay alive or avoid starvation or death. This difference would not have been predicted from what is known about gender role socialization, and we have no interpretation for it.

Relationships Among Response Categories

Although our interests lay more in group differences in response patterns, we also correlated scores for the different response categories, within and across question clusters, to see if any noteworthy relationships emerged. Most of the significant correlations were not especially interesting because they fit into one of three expected patterns. First, many were logically necessary negative correlations between mutually exclusive category alternatives within the same cluster (e.g., there was a negative correlation between failure to give an explanation for why people need food and the categories used to code the explanations that were given by the students who were able to do so). Second, many were logically necessary positive correlations that represented part-whole relationships (e.g., there was a positive correlation between the category for stating that food provides energy when answering Question 1 and a later category used for indicating that at some point in responding to the first two questions, the student described food as a source of energy for the body). Third, there was a general tendency toward correlation within and across clusters in the length and quality of the students' responses (i.e., certain students were more likely than others to be unable to respond or to respond poorly to our questions; certain students were more likely than others to consistently make lengthy and complex responses; and certain students were better informed than others and thus more likely to consistently make sophisticated responses). Given that these three types of relationships were expected to appear and that the explanations for them

are well understood, we will not describe them in this report unless there is some special reason to do so.

In addition to these expected relationships, however, the correlational analyses sometimes identified statistically significant relationships between response categories that would not necessarily have been predicted and that indicated interesting connections among students' ideas. Most of these interesting relationships involved categories that reflect qualitative differences in the ways that students approached the questions, as opposed to categories that reflect differences in the amount or accuracy of their knowledge.

Interesting correlations involving categories for coding responses to Question 1 mostly involved the response that food provides energy. Students who made this response also said that good foods give you energy in responding to a later question asking them about what makes good foods good. They also were more likely than others to say that good foods contain vitamins and nutrients and that bad foods contain a lot of fat. Other correlates of this response included various categories coded more frequently for older and better informed students, which together comprise what might be called a "maturity pattern" in responses to the interview as a whole: being able to list four or more conventional food groups, understanding key differences between foods that are good for you or not good for you, understanding steps in making bread or growing corn, understanding how machines have made farming more efficient and being able to identify some of those machines, and so on. This pattern of relationships with the "food provides energy" response supports our interpretation that this response was more sophisticated than the other common responses to Question 1 (represented by the other coding categories).

There were few significant correlations with other responses involving the remaining categories for Question 1. Most of those that did appear were indications of consistency in the students' thinking. For example, students who responded to Question 1 by saying that we need food to grow were more likely than other students to respond to a later question about good foods by saying that good foods help you grow. Similarly, students who answered Question 1 by saying that we need food to be healthy were more likely to answer the later question by stating that good foods are good because they keep you healthy, and students who answered Question 1 by stating that food is needed to make us strong were more likely to answer the later question by stating that good foods are good because they make you strong.

Rare and Unique Responses

The responses to Question 1 were well captured by the coding categories. As illustrated by the previously presented examples drawn from eight average-achieving students, responses to this question tended to be brief, free of misconceptions, and accurate as far as they went but limited in sophistication. Perhaps the only response worth noting here is that of a high-achieving third grader whose answer was easily the most complete and best informed. When asked why we need food, she said, "Because it's part of our survival. We eat the food and it goes down our esophagus into our stomach and our stomach grinds it up and makes it a liquid and then it can go through our blood and it makes energy for our body."

Further discussion of responses to Question 1 will be included in the discussion of responses to Question 2.

The Nature of Food

Our second question assessed students' understanding of the nature of food, in terms of both defining what it is and contrasting it with nonfood:

Question 2. What is food? . . . How is food different from things that are not food?

Responses to the two parts of this question were coded separately, and results of the analyses of these responses are given under the headings for Questions 2A and 2B in Table 1. Almost 20% (18) of the students were unable to respond when asked "What is food?" Of the rest, a majority (54) said that food is something that people eat, 21 simply listed food items as examples but did not give a definition, and 12 said that food is good for you, makes you healthy, etc. Another 16 responses were substantive and relevant to the question but did not fit into the previous categories.

Question 2B asked how food is different from things that are not food. Here, almost a third (31) of the students were unable to respond. The rest supplied one or more of the following responses: stating that food is eaten and nonfood items are not eaten (25), listing food and nonfood items as examples (21), naming nonessential characteristics when defining food (it's food if it looks like food, doesn't walk, is not hard, has seeds, etc.) (16), stating that food has taste or tastes different from nonfood (14), stating that food provides health benefits or contains vitamins or minerals (11), or stating that food is healthy or good for you (10).

A final code was applied by considering everything said in response to the first two questions to determine whether or not the student ever described food as a source of energy for the body. The results of this coding indicated that only 14 students made this response.

Note that the categories for Question 2B are numbered 0, 1, 2, 3, 4, 5, 6, and 8, respectively (i.e., number 7 is missing). Here and throughout the table, these occasional

missing numbers indicate instances in which categories used in the original coding were dropped from the analyses because they were not used frequently enough to justify their retention. Any responses originally coded in these categories were redistributed to more commonly used categories (where appropriate) or else omitted entirely from the statistical analyses but included in the listing of rare and unique responses.

The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

> Potatoes, meat, veggies. (How is it different from things that are not food?) I don't know.

Kate

> Stuff you eat. (How is food different from other things that are not food?) I don't know.

First Grade

Chris

> Food is bread or macaroni and cheese, chicken noodle soup, and all that stuff. (How is food different from other things that are not food?) Because it doesn't walk or nothing. (What do you mean?) Like food doesn't walk and animals do.

Lauren

> It's healthy. (How is food different from other things that are not food?) Well, you can eat food, and you can't eat like a chunk off of stuff. You can eat apples and you can't eat rocks.

Second Grade

Mark

> Food is something that you eat, like meat, bread, and vegetables and fruit.

Emily

Um . . . something you eat. (What does food have that other things don't have?) I don't know.

Third Grade

Dale

Food is like bread and made up of these little crinkly things and they have like crumbs in it. I think they are made of like storage package people who make it with a big machine. (What does food have that other things don't have?) Vitamins. Chewiness. Something you can eat with a fork and spoon. (Well, are there things that we can eat that are not food?) No, you can't eat the things that aren't food.

Chelsea

It's something that you eat. (How is food different from other things that are not food?) Because it makes you grow and get healthy and strong.

Grade Level Differences

There were three significant relationships with grade level among the categories for responses to Question 2A. Younger students were more likely to be unable to define or describe food, whereas older students were more likely to say that food is something that people eat or to supply "other" responses that did not fit into the major categories (primarily more sophisticated responses, as shown later in the listing of rare and unique responses).

Significant relationships with grade level appeared for seven of the eight categories used to code responses to Question 2B (How is food different from things that are not food?). More of the younger students were unable to respond to this question and more of the older students distinguished food from nonfood items by indicating that food has taste, provides health benefits, or provides energy. Older students also were more likely than younger students to simply list examples of food and nonfood items and to suggest distinctions that

were incorrect or that referred to characteristics that are not essential to foods (looks like food, doesn't walk, not hard, has seeds, etc.).

Finally, a nonlinear relationship with grade level appeared for responses indicating that food is eaten but nonfood items are not. This response was more common among first and third graders than among kindergarteners and second graders. This nonlinear pattern was not expected, and we have no explanation for it (the correlations between categories for responses to Question 2B and all of the other coding categories did not yield interpretable patterns, and nothing that we know about cognitive development or the school curriculum across the K-3 range suggests an explanation for this finding). We also are unable to offer explanations, or even tentative interpretations, for most of the other nonlinear relationships that appeared in our analyses. Rather than continue to repeat our explanations for why this is the case (the nonlinear patterns were unexpected, their reliabilities are unknown, and nothing in the correlational analyses or the extant research literature suggests clear interpretations), throughout the rest of this report we will simply describe nonlinear patterns without commenting on them (except in a few instances where we do have interpretations to suggest).

In general, the findings from analyses for the first two questions indicate that the older students were able to say more about food (why we need it, what it does for us) than the younger students, and that most of what they had to say was accurate as far as it went. Almost all of the students understood that we need food to sustain life and remain healthy, and majorities were able to define or describe food and distinguish it from nonfood. However, many responses were based on appearances or external characteristics (food has taste, contains juice or seeds, etc.) or involved circular reasoning (You eat things because they are food and

food is food because you eat it) or reversed logic (foods are things you can eat with a fork or spoon).

Achievement Level and Gender Differences

Unsurprisingly, more lower achievers than average or high achievers responded to Question 2A by listing food items as examples instead of by defining food. The other two significant relationships for this set of categories are difficult to interpret: a nonlinear relationship with achievement indicated that more average achievers than high or low achievers said that food differs from nonfood because it is eaten, and a relationship with gender indicated that more girls than boys were coded for "other" responses to Question 2A that did not fit into the other categories.

Relationships Among the Categories

The correlations identified only a few interesting relationships involving responses to Question 2. Students who answered Question 2A by defining food as something that people eat were more likely than other students to answer Question 2B by stating that food is eaten and nonfood items are not. These students also were more likely than other students to respond to a later question by stating that we refrigerate some foods to keep them from making people sick. In answering Question 2, many of the students who said that we eat food items but do not eat nonfood items went on to say that eating nonfood items could make us sick.

Similarly, students who answered Question 2A by saying that food contains things that are healthful and good for the body were more likely than other students to respond to a later

question by saying that bottles and cans are sealed so that nothing bad can get to the food (and render it not good for you).

Students who distinguished food from nonfood by stating that food contains vitamins, minerals, or other healthful ingredients also were more likely than other students to describe food as a source of energy for the body, to correctly identify foods that Japanese people eat, to know that Chinese people raise relatively more chickens and American people relatively more beef cattle, to know that we get meat from sheep, and to say that good foods are good for you because they contain vitamins, minerals, proteins, fiber, etc. These responses, along with responses identifying food as a source of energy for the body, formed part of the maturity pattern seen in students who tended to provide more sophisticated responses throughout the interview.

Rare and Unique Responses

The following responses to Question 2 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories. Most of these responses have been paraphrased to save space and focus on their key ideas, although we have quoted verbatim when it appeared worth doing so.

Kindergarten: If people put poison in pumpkins, you can't eat them; some things have lots of sugar and some don't have any sugar at all; some have stems and some just have juice inside them; food makes you healthy and makes you feel good—animals eat food too.

"People need food because if they don't eat food they get poor. Food is good for you and it's healthy. You can't just eat junk all the time. You have to eat food and carrots and apples to make you healthy and grow up. (How is food different from nonfood?) Candy has sugar and

fruit does too, but carrots don't have sugar inside. Dip has a taste to it and carrots do too. Carrots have juice inside and dip doesn't. Dip has taste and carrots don't."

First grade: List of nonfoods includes clover and things that have gotten poisoned; food is stuff that you eat that is "part of the food chamber"[food chain]; some things are poison rather than food; foods are healthy but nonfoods are not good for you and if you eat them you might die; food has vitamins and stuff in it that are good for people; you don't eat horses; you can eat apples but you can't eat rocks; food is not plastic—you can't eat plastic; food makes you healthy and hardly anything else makes you healthy.

Second grade: Other things like candy and stuff make you not healthy; we eat food to get protein and stay alive; sunflower seeds are not food; candy is not food; you can't eat leather because it is not good for you; food is not a liquid like water or medicine, but a pill is food and paper or a table are not food.

"Food is something that your body turns into blood. It is not a liquid like water. Some stuff, like grass, is only for animals to eat. Apples are only for people because grass has this stuff and there's dirt and stuff and there's some different kinds of seeds and apples have a different kind of seeds that grow trees."

Third grade: Plants' flowers and "bugs and things" are not food; food is not liquid, we can't eat water—we have to drink it; food doesn't come out of the sky; food has vitamins and chewiness and you can eat it with a fork and spoon; food is fiber; poison mushrooms are not food; initially lists soups as things that we can eat that are not food, but when asked why soup isn't food, says that it is; food has energy and when you eat it, it helps you get bigger, whereas if you eat plastic, it doesn't help you get bigger; initially lists candy, ice cream, and cake as nonfoods, but says that they are a kind of food when the interviewer questions this; food differs

from nonfood because it tastes like something and is not hard; all food grows—grains, vegetables, fruits, and meat.

The high-achieving girl who gave the best response to Question 1 (quoted earlier) also went on to give the best response to Question 2, including the only reference to nutrition: "Lots of things are not food. As a baby, you could eat nontoxic things or paper. Sometimes people swallow money. People eat a lot of things that they shouldn't. (So then what does food have that other things don't have?) Nutrition, vitamins, minerals."

Discussion

Responses to the first two questions were generally free of misconceptions and accurate as far as they went, although most students' knowledge about food was limited to its surface appearances and gross physical characteristics. The students knew that we need food to survive but few of them understood much about the nature of food or how it exerts its effects on our bodies, even though they sometimes used terms such as "energy" or "vitamins." Most students said that we need food to stay alive or that it provides energy, keeps us healthy, or helps us grow. Some of them made further reference to these same characteristics of food when asked to define food or distinguish it from nonfood. However, others referred to nonessential characteristics in defining food, displayed circular reasoning or reversed logic (e.g., food is stuff that you can eat with a fork and spoon), or classified potentially edible substances as nonfoods on the basis of convention rather than fitness as an energy source (bugs, flowers, clover, horses, sunflower seeds, leather). Other observed confusions included classifying pills or vitamins as food; defining food as things that are eaten that are solid

(including pills) but classifying liquids (water, soup, medicine) as nonfoods; and contrasting good vs. bad food instead of food with nonfood.

Food Groups

Our third question assessed students' familiarity with the food groups emphasized in nutrition education:

Question 3. Scientists talk about different food groups. Have you heard of food groups? . . . What are some of the food groups?

More than a third (34) of the students had not heard of food groups or were unable to list any. Of those students who were able to respond, most referred to conventional food groups, although they sometimes used alternative terms (that we accepted): bread or wheat for grains, sugars for carbohydrates, milk for dairy, and "the ones like candy and butter," "desserts and stuff," or "other—chocolate and all that" for fats. Twenty-nine students listed one, two, or three conventional food groups and 25 listed four or more. Finally, 20 students instead listed individual food items (cheese, apples, etc.) or unconventional food groups (purple, green, etc.; breakfast/lunch/dinner; meat/deli/fruit).

Five students referred to the food pyramid, either directly or indirectly (i.e., through references to "at the top"). In addition, a few explained that you are supposed to eat more of the better foods and less of the bad foods. The following examples from average-achieving boys and girls are representative of the responses from students across the grade levels.

Kindergarten

Jered

No.

Kate

No.

First Grade

Chris

The food groups are fruit, vegetables, grain, and juices.

Lauren

Five food groups. Fruit, meat, and milk and stuff are all food groups. Peanut butter is in the meat group. It's kind of like meat.

Second Grade

Mark

Grain, vegetables, fruit, dairy, and . . . I've heard of them all but I forgot the names of them.

Emily

My health teacher taught me: there are vegetable groups, meat groups, the grain groups, the . . . I can't get the rest of them.

Third Grade

Dale

I've heard of all of them. There's the sweet at the top, there's the grain, fruits, veggies, the dairy, and the meat.

Chelsea

Vegetables, fruits, . . . grain, . . . meat.

Grade Level Differences

As expected, the older students knew more about food groups than the younger students did. Younger students (especially kindergarteners) more often were unable to respond,

whereas older students more often were able to list four or more conventional food groups. The coding for listing one, two, or three conventional food groups showed a nonlinear pattern, being used more frequently for first and second graders than for kindergarteners or third graders. As a group, the second graders knew the most about food groups, perhaps because this information was taught late in first grade or early in second grade. The findings from all of our interviews frequently indicate that second graders communicate at least as much information about the topic as third graders do.

Achievement Level and Gender Differences

The only significant relationship involving categories for responses to Question 3 was a nonlinear relationship with achievement level. In this case, the nonlinear relationship makes sense: Average achievers were more likely than lower or higher achievers to list one, two, or three conventional food groups. This is readily understandable given nonsignificant trends indicating that lower achievers were more likely to fail to list any conventional food groups and higher achievers were more likely to list four or more.

Relationships Among the Categories

The only noteworthy correlations involving these categories were for Category 3. The students who were able to name four or more conventional food groups in responding to Question 3 tended to be among those who made relatively sophisticated responses to all of the questions in the interview and thus created the maturity pattern of correlations seen for the corresponding response categories.

Rare and Unique Responses

The following responses to Question 3 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Kindergarten: Fat and skinny ones; purple, orange, yellow, green.

First grade: Peanuts and the meat one, vegetables, the corn one, the green ones, and like the food chamber; peanut butter is in the meat group, it's kind of like meat; "another group has fruit in it, and you might not think of this as being fruit, but it includes tomatoes—I learned that on a cooking show one day. (Why is it a fruit, then?) Because it tastes a little bit like a fruit and it's juicy like a fruit and some people use it like a fruit."

Second grade: You should not eat much junk food but you can eat some sweet candy once in a while; I heard about seafood groups; says that she learned about food groups from her health teacher.

Third grade: Breakfast, lunch, and dinner; meat, deli, and the fruit section; most of them are healthy except the top one—that's fat and you don't want to eat fat because it's not good for your body; one is called the "other," but it's really like chocolate and all that, and then there's vegetables, meats, grains, and dairy.

The same third grade girl who gave noteworthy answers to the first two questions gave the following answer to Question 3: "It all goes in a pyramid. The bottom one is grains like bread, cereal, rice, and noodles, and you should eat 8 to 11 servings a day, and then the next storey up is fruits and vegetables and you should eat, I'm not sure how much, but it's like apples and stuff and you shouldn't eat as much of those as grains, but you should still eat quite a bit. There's dairy and protein, and dairy helps your bones get stronger, and protein gives you energy and calories. Then there's fat at the very top, which is the smallest, and you should

kind of narrow those down to the smallest that you eat, and there's like candy and other things that have a lot of sugar and stuff."

Discussion

Most of the kindergarteners knew little or nothing about conventional food groups, whereas most of the second- and third-graders could name at least some of them. These findings are comparable to those reported for children of similar age by Michela and Contento (1984) in that many children referred to the Basic Four food groups emphasized in nutrition education (although not always using the scientific labels for them) but many others suggested categories based on something other than the foods' nutrient compositions. However, the students' responses to this and certain subsequent questions (especially about healthful vs. junk foods) suggested that they were a little more knowledgeable about the relationships between food and health than were the students interviewed by Michela and Contento. This probably reflects the increased emphasis on nutrition education that has occurred in recent years, leading to the near-ubiquity of food pyramids and discussion of food groups and recommended diets. Such instruction is included in the state's curriculum guidelines for health and guidance classes in Michigan elementary schools.

Changes Over Time in American Diets

Questions 4 and 5 were designed to probe students' knowledge of ways in which patterns of food consumption in the United States evolved during the twentieth century:

Question 4. Think about the foods that people ate about 80 years ago, around 1920. Do we have foods today that they didn't have in 1920? . . . Why didn't they have those things back then?

Question 5. Back then, did they eat some foods that we don't eat today?

Most of the students had difficulty with these questions. Fifteen of them could not answer Question 4, 14 answered incorrectly by saying that there are no foods available today that weren't available in 1920 as well, and another 14 said that there are such foods but could not give any examples. Furthermore, among the 53 students who knew that we have foods today that people didn't have in 1920 and went on to give examples, 47 incorrectly listed one or more foods that were available in 1920. In addition or instead, 19 of these students correctly listed foods that were not available in 1920 (fast food, pizza, many junk foods and candies, etc.). To explain why the foods were unavailable, 17 said that people didn't know how to make them then or lacked the technological capabilities for doing so, 12 said that the foods hadn't been invented yet, and 6 said that the foods existed elsewhere in the world but were not available locally (e.g., chocolate).

The findings for Question 5 indicated that 18 students were unable to respond and 36 said that people in 1920 did eat some foods that we don't eat today but were unable to give examples. Among those students who did suggest examples, 12 incorrectly listed foods that are still eaten commonly today but 16 were able to identify one or more foods that are not typically eaten today or are eaten much less frequently (buffalo, squash/gourds, brains, molasses). Contemporary American eating practices (featuring emphasis on processed/ packaged foods, frozen foods, ethnic and other specialty foods, and frequent consumption of meals at family restaurants or take-home food from fast food outlets) were all that most of

these students had ever known, and most had little awareness of the degree to which this pattern is a recent development that contrasts in many ways with the meat-and-potatoes meals emphasized in the first half of the century. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

4. Marshmallows. (Why didn't they have marshmallows?) I don't know. They probably weren't done with them. (What do you mean by done with them?) They were making the marshmallows [i.e., they hadn't finished inventing/developing them].

5. They drank mud. There was no drinks for them. There was no milk or stuff, so they had to drink mud.

Kate

4. Yes: salad, carrots. (They didn't have carrots in 1920? Anything else?) Yeah, hamburger meat.

5. No.

First Grade

Chris

4. Macaroni and cheese or plain old cheese. (OK. And why didn't they have them back then?) Because they didn't know how to make them.

5. They ate the same kind of food that we do.

Lauren

4. Apples. (Did they have them back then or not?) I don't know. (Anything else you can think of?) Bananas. (Why didn't they have bananas back then?) Um, because they hadn't invented them.

5. Um . . . [no response]

Second Grade

Mark

4. They had vegetables and fruit . . . (But do we have anything that they didn't have?) Yeah, like grains, meat . . . no they had meat. I'm not really sure.

5. Yeah, I think so. (Can you think of anything?) No.

Emily

4. I think they didn't have macaroni and cheese or Popsicles or . . . I know they had ice cream, but the other things I don't remember. (Now why didn't they have those back then?) Probably the people that make the food, they didn't think of Popsicles or macaroni.

5. No.

Third Grade

Dale

4. Um . . . no. They probably had apples then, though.

5. Well, they didn't have really as much foods because they just had fruits and we have . . . well, they had bread—I know that. They had no sweets back then. I know that. (Why not?) Because they didn't have any stores back then, they didn't have lots of food back then, they didn't' have lots of drinks and stuff. (Why didn't they have stores and the foods and the drinks?) Because there were no builders back then cause they didn't have any wood, they didn't have any paint, they didn't have any nails. (Did they eat some foods that we don't eat? You said fruit but we eat fruit, don't we?) Yes, we eat fruit. They had molasses back then and we still have it today, and . . . [no further response].

Chelsea

4. Cake, donuts, ice cream . . . candy. (Why didn't they have candy back then or ice cream or cake back then?) Because it wasn't really healthy for them. (Can you think of any other reasons?) [very long pause] Because they didn't have a lot of medicine back then if you got sick.

5. Yes. (Can you think of some examples?) . . . No.

Grade Level Differences

Younger students were more likely to be unable to answer Question 4. The next two categories (saying no to the question or saying yes but being unable to give examples) showed

no significant relationship with grade level. The remaining categories were coded more frequently for the older students. These included the category for incorrect examples as well as the category for correct examples, along with all three of the categories for explanations of why foods eaten today were not eaten in 1920.

The categories for Question 5 were less clearly related to grade level. There was a nonlinear relationship for stating that people in 1920 ate some foods that we don't eat today but then being unable to give examples, and a positive relationship for giving accurate examples. Fourteen of the 16 students who provided accurate examples were second- or third-graders. In summary, although the older students displayed more knowledge about early vs. late-20th century American eating patterns, only a minority of even the older students displayed much accurate knowledge in this domain.

Achievement Level and Gender Differences

There were three significant relationships with achievement level but none with gender for categories of response to Questions 4 and 5. The low achievers were most likely and high achievers least likely to be unable to respond to Question 4. Surprisingly, there was a positive relationship with achievement level for incorrectly listing foods that were in fact available in 1920. Note, however, that this category also showed a positive relationship with grade level. Apparently, although this response was not as sophisticated as responses that correctly listed foods that were not available in 1920, it was a more sophisticated response to Question 4 than those given by students who said that they didn't know, said that there are no foods now that didn't exist in 1920, or said that there are such foods but could not venture any examples at all.

It was the older and (within grade) higher achieving students who were able to generate substantive examples, although these examples were more likely to be incorrect than correct.

The final relationship with achievement level was for the explanation that certain foods such as chocolate existed elsewhere in the world but not at the place and time in question. Five of the six students who made this response were high achievers.

Relationships Among Response Categories

There were several noteworthy correlations involving categories for Question 4. First, students who said no to this question (i.e., who said that what we eat today is the same as what Americans ate in 1920) were more likely than other students to respond to a later question by stating that there are no differences between what Americans eat and what the Japanese people eat. Thus, this subset of students appeared to believe that foods are the same everywhere and have been throughout history, or at least for a long time.

Students who said yes to Question 4 but could not explain or give examples were more likely than other students to be unable to respond to other questions or to give only low-level responses.

Students who correctly listed foods that were not available in 1920 were likely to go on to explain that these foods were not available because people didn't know how to make them or lacked the technological capabilities to do so (e.g., pizza ovens). Both of these responses were also correlated with the maturity pattern of sophisticated responses to other questions. The fourth category for responses to Question 5 (accurately mentioning a food commonly eaten in 1920 but not today) also correlated with other categories that make up this maturity pattern.

Rare and Unique Responses

The following responses to Questions 4 and 5 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 4

Kindergarten: They had to make all of their food, but we can buy some of ours; marshmallows hadn't been invented yet.

First grade: They didn't have pizza, corn, jelly, or peanut butter because they lived before us and Jesus didn't have that much food, so he didn't put much food out; they didn't have eggs because nothing that laid eggs was there that was big enough; they only had foods that have seeds in them (i.e., foods that you can grow); they didn't have soda, beer, or popcorn because we have electricity and they didn't, so they couldn't run a lot of stuff; we have Pop Tarts but back then they didn't know how to make them; macaroni and cheese—they didn't know how to make them; bananas, because there were no banana trees; corn, peas, and mashed potatoes, because they didn't have stoves or microwaves or electricity or a grill (note reversed reasoning); candy and ice cream, because they didn't know about sugar.

Second grade: Fruit and meat, because they didn't have the seeds to grow them; packaged foods, because they didn't grow on trees; carrots, green beans, and peanuts, because they didn't have seeds then; little sweets, because they didn't know how to make them and didn't have the machine needed to make them; strawberries, corn, watermelon, cereal, and soup, because there were not a lot of groceries where you could get food; they didn't have cereal, only like apples and stuff, because they didn't have the machines to make cereal; they

didn't have like ice cream and candy, because every year people get better and better at making stuff, so almost every year we have a different kind of junk food—and more healthy food too.

The following is quoted as an extended thoughtful response, even though parts of it are not correct: "I think there would be a lot of bread products, but not a lot of sweets—things with sugar. And there probably was a lot of harvesting, like pumpkins and gourds. There probably was a lot of turkey on the table at Thanksgiving. (Do we have foods today that they didn't have in 1920?) Well, there might not be such a thing as macaroni and cheese or cakes and stuff like that, because there probably weren't a lot of noodles and they probably didn't use cheese very much or know much about dough or bread products."

Third grade: We have more machine-packaged foods that have a lot more fats and sugars and a lot less just vegetables; Hot Pockets—they didn't think of a pizza rolled up then; they had no sweets back then because they didn't have stores (goes on to say that they lacked needed building materials and machines); they didn't have broccoli, milk, or orange juice because they didn't know a lot of stuff then that we know about now because we have scientists (goes on to say that they also didn't have news media to spread the word about new inventions quickly); they didn't have hamburgers because they didn't have a grill or anything; they didn't have cake, donuts, ice cream, or candy because it wasn't healthy for them and they didn't have a lot of medicine back then if you got sick (i.e., we can eat these things now because we have better medicine).

"People used to eat sheep but today farmers own them . . . people didn't have enough food back then, so they had to eat animals . . . We just go to a food store and like McDonald's and go up and say we want a hamburger" [apparently does not consider this to be eating animals].

Question 5

Kindergarten: There were no drinks for them, no milk or stuff, so they had to drink mud; they ate and drank red stuff out of coconut trees; beet greens.

First grade: Deer (goes on to say that we don't eat much deer today because there are not as many deer); dinosaurs.

Second grade: Deer meat, squirrel, rabbit; we don't eat their kind of soup and all their beer stuff, and we don't find buffalo and take out their hearts and eat them (thinking of Indians); porridge, because we can't find it today; they killed wildlife to get food, but we don't kill them ourselves—the people that kill them bring them to the store where we buy it; buffalo, because we can't hunt them.

Third grade: Really thick bread that they used back then; buffalo; sheeps' insides that they used to eat; molasses; sheep, because then people didn't have enough food so they had to eat animals, but we can just go to a food store or go to McDonald's and get a hamburger; hard ice cream and hard strawberries that we wouldn't like today; they might have had just one flavor of pudding, but we have lots of flavors (one of several responses suggesting that foods were essentially the same then but more basic or less elaborated); berries picked from the woods—we don't pick them ourselves now, people go out in the woods and pick them and then put them in stores (note lack of knowledge of orchards and other aspects of the modern food industry); they ate a different kind of corn bread—normally they didn't have salt, so all they used was corn meal and water.

Discussion

When asked about foods that we eat today that were not around in 1920, most students couldn't respond or incorrectly listed foods that were available then. Many students recognized packaged junk foods as modern inventions, and we counted these as well as pizza, fast foods, and a few others as correct answers. Only a minority of the students were able to offer explanations for their responses (e.g., foods like chocolate were available but not locally, foods were not available because the concept for them had not been invented yet, or foods were not available because people didn't know how to make them or lacked the technology to do so). Many of these explanations were given with respect to incorrect statements about foods available at the time. Of the 16 students who gave examples of foods not available in 1920 that we considered correct, 10 also suggested incorrect examples. Of the 6 who supplied only correct examples, just 4 added explanations for why these foods were not available at the time.

Many students were confused about the time period in question and answered in terms much farther back than 1920. Many referred to the pioneers or to Native Americans, and a few went back to prehistoric human times or even the days of the dinosaurs. In this regard, some of the statements made about the past referred not to the foods themselves but to activities involved in obtaining them, such as gathering berries or hunting game in the forest. At least a few students, who were unaware of contemporary food production and distribution practices, thought that much of the meat and produce sold in supermarkets is obtained from individual hunters or gatherers who bring it to the store and sell it.

The students found Question 5 even more difficult. Here they gave many fewer answers and most of the answers they did give were incorrect (i.e., identifying foods that are still eaten commonly today). However, a minority of students did mention obsolescent foods such as buffalo, gourds, sheep brains, or molasses, and a few made statements indicating that

the same foods were eaten but in less satisfactory condition (hard strawberries, icy ice cream). Many of the incorrect answers involved fruits or vegetables. Students who made these responses understood that these are among the most elementary of foods, so they reasoned that in the past, it was not so much that people ate different foods, but that almost all of what they ate was food that they grew or raised themselves. This reasoning would have enabled them to construct an accurate response if we had been asking for comparisons to the 18th century or earlier, but it led to incorrect responses when the reference year was 1920. Only a handful of students showed much awareness of the relatively recent vintage of modern food processing and packaging methods or of the degree to which certain foods that we now take for granted (especially frozen foods and other convenience foods prepared and packaged to minimize preparation time) have become commonplace only in recent decades.

Foods Eaten in America and in Other Parts of the World

Questions 6 and 7 probed students' knowledge of contrasts between foods commonly eaten in the United States vs. in other parts of the world:

Question 6. Are there some countries where people eat different foods than we eat? . . . What do they eat? . . . What do we eat that they don't eat?

Question 7. Think about Japan. Do the Japanese people eat different foods than we do? . . . What things do the Japanese people eat? . . . What do we eat that the Japanese people don't eat?

The students had as much trouble with these geographical/cultural comparisons as they did with the historical comparisons addressed in Questions 4 and 5. Only 13 students were unable to respond to Question 6, but 6 answered it incorrectly by suggesting that everyone eats

the same foods and another 36 said that there are countries where people eat different foods than we eat but were unable to give any examples. In addition, 22 students identified foods commonly eaten in the United States that they thought were not commonly eaten in many other places, but only 12 of these gave examples that we considered correct (peanut butter, packaged cereals, hot dogs). Examples considered incorrect included fruit, vegetables, and sandwiches.

Finally, some students gave examples of foods eaten elsewhere that are not ordinarily eaten here. Of these, 27 listed specific foods conventionally associated with other countries (hot peppers, egg rolls, pizza, Chinese chicken dishes, fortune cookies, French bread, etc.), 9 mentioned generic ethnic foods (Chinese food, Italian food, etc.), and 7 suggested exotic or questionable examples (cheetahs, tigers, spiders, slugs, or snow). In summary, among the 96 students, only 12 could identify a food commonly eaten in the United States but not in many other places and only 27 could identify specific foods eaten more routinely elsewhere than here.

The students were better able to respond when asked specifically for comparisons with the Japanese. Only 10 of them were unable to respond to Question 7, only 6 said that we eat the same foods, and only 15 said that there were differences but were unable to give examples. Among those who gave examples, 22 listed conventional Japanese foods (noodles, rice, fish, sushi, tofu) and the others identified foods commonly eaten here but presumably not in Japan. These included 33 students who mentioned American family meal foods (macaroni and cheese, steak and potatoes, barbecued chicken, pizza, ravioli), 32 who suggested that Americans eat fruits and vegetables but the Japanese people do not, and 15 who noted that Americans eat a great deal of candy and other processed junk foods. Responses that focused on American foods (those coded in Categories 3, 4, and 5 for Question 7) were further coded to determine if

they included at least one American food that Japanese people ordinarily would not eat. This secondary coding indicated that 40 students identified one or more such examples (primarily those who spoke of American family meal foods or processed foods). The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

6. Yeah, China food, Spanish, Holland, England. (What do they eat in those countries that we don't eat?) I like their egg rolls, but we eat those. (Do we eat anything here in the United States that they don't eat?) I don't know. Yeah, Spanish don't eat anything we eat. (What do they eat? . . . What do Spanish people eat?) I don't know.

7. Yeah. (What do they eat that we don't eat?) I don't know but I know they eat different stuff. (Do we eat anything that they don't eat?) I think so.

Kate

6. Yeah. (Can you give me some examples?) No.

7. Yes. (What things do the Japanese people eat that we don't eat?) I don't know what they eat.

First Grade

Chris

6. Some countries eat just . . . I don't know what, but I know that some countries have different food. (Can you think of particular countries?) No.

7. Yup. (What do they eat that we don't eat?) I don't know. (What do we eat that they don't eat?) Macaroni and cheese and chicken noodle soup and all that stuff.

Lauren

6. Germany. (What do they eat in Germany that we don't eat here?) I can't think of anything. (Do we eat anything that they don't eat?) I don't know.

7. Yeah. (What do they eat that we don't eat?) [long pause] I can't think of anything. (Do we eat anything that they don't eat?) Yeah, but I can't think of anything.

Second Grade

Mark

6. Yeah. China and . . . Asia, I think . . . Africa, South America. (Can you think of some of the things that they eat that we don't eat? For example, in China or Africa?) In China they have noodles and like . . . I'm not really sure what else. (What about in some of the other places you mentioned, like Africa?) Africa . . . I'm not very sure about some of those places. (Do we eat anything that people in those other countries don't eat?) Yeah, like we have meat and stuff, and grains. I don't think they have any of that stuff, but I'm not very sure.

7. They have different stuff like China has. (Do we eat anything that the Japanese people don't eat?) I think so, like grains and fruits and stuff like that.

Emily

6. In the rain forest, people just eat plants. (Why do they eat that we don't eat?) We eat like macaroni and all that other stuff, but they eat like plants and coconuts, fruits. Sometimes we eat fruits, but they just eat them without cleaning them.

7. Sometimes they eat chicken and rice a lot, but sometimes they eat with these things [pantomimes using chopsticks.] (Chopsticks.) Yeah, chopsticks, and they eat fish. (What things do we eat that the Japanese people don't eat?) We don't eat with numchucks, they don't eat ice cream or Popsicle sticks or macaroni.

Third Grade

Dale

6. Well, there are lots but I can't think of the names of them.

7. Well, they eat like bowls . . . with coconut bowls and stuff. They had coconut food. Let's see here. . . . They have water, they could have crab cause there's lots of sand. (Do we eat anything that they don't eat?) Well, we eat canned peaches. They eat coconuts and drink coconuts, and we eat . . . well, they eat crab and we eat crab. We eat meat, we eat soup, and they drink water, and they sometimes get stuff by trees.

Chelsea

6. Yes. (Can you think of examples?) I'm not so sure.

7. Rice, vegetables, and turkey. (Are there things that we eat that the Japanese people don't eat?) Pie, cake, ice cream, candy.

Grade Level Differences

Three of the categories for Question 6 showed significant relationships with grade level. The younger students were more likely to be unable to respond to this question and the older students were more likely to be among those who offered the most specific and accurate responses (those who identified specific foods conventionally associated with other countries or typically American foods that are not eaten in many places).

Significant relationships with grade level appeared for six of the eight categories of responses to Question 7. The pattern was slightly unusual in that there was no difference in the rate of response failures—younger students were just as likely to respond to this question as older students. However, younger students were more likely to be coded for answering the question incorrectly by saying that we eat the same foods or for stating that we eat different foods but being unable to give examples.

There also was no significant grade level trend for the incorrect statement that Americans eat fruits and vegetables but Japanese people do not. The remaining categories all reflect accurate responses, and each of these showed a positive relationship to grade level. Older students were more likely than younger students to say that Americans eat more candy or processed foods, more traditional American family meal food, and less conventionally Japanese food.

Achievement Level and Gender Differences

As might have been expected, the incorrect response that Americans eat fruits and vegetables but Japanese people do not showed a negative relationship with achievement level

and some of the more sophisticated responses (being able to list specific foods conventionally associated with other countries, stating that Americans eat candy or other processed junk foods, and being able to list conventional Japanese foods) showed positive relationships. Thus, higher achievers generally gave more sophisticated responses than lower achievers. However, the incorrect claim that everyone everywhere eats the same foods (made by only six students) showed a positive relationship with achievement level. This was unexpected and we offer no interpretation for it.

These categories also showed three significant relationships with gender. Boys were more likely to list American foods that people in other countries presumably do not eat and to say that people in other countries eat generic ethnic foods, whereas girls were more likely to say that the Japanese people eat different foods than we do but to be unable to give examples. These are all intermediate level responses, better than response failures or incorrect answers but not as good as the most sophisticated responses in each set of categories. They do not seem connected to known differences in gender socialization.

Relationships Among the Categories

None of the categories for Question 6 showed interesting relationships with categories for other questions except for Category 7. Students who were able to list specific foods conventionally associated with other countries were more likely than other students to list specific crops or dishes brought to America from other countries in answering Question 8, to know that bread is made from grain ground into flour, to know that it is difficult to grow crops in Alaska, to know that machines are primarily responsible for improvements in farming efficiency, and more generally, to be coded for the categories that comprise the maturity set.

Students who answered no to Question 7 were more likely than other students to be unable to respond or to give "other" responses to several of the other questions. As a group, these students had unusual response patterns. Students who answered yes to Question 7 but were unable to explain or give examples were more likely than other students to be coded "doesn't know/no relevant response" for other questions. Students who said that Americans eat a lot of candy and other processed junk foods were more likely than other students to answer Question 2B by saying that food differs from nonfood because it contains vitamins or minerals or provides other health benefits, as well as to say that bottles and cans are sealed so that nothing bad can get into the food. Thus, these students were unusually health conscious in their thinking about food.

Children who were able to identify conventional Japanese foods in responding to Question 7 were more likely than other students to be coded in the maturity set of responses to the interview as a whole. The same was true of students who accurately listed American foods that Japanese people ordinarily would not eat.

Rare and Unique Responses

The following responses to Questions 6 and 7 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 6

Kindergarten: Hot peppers; egg rolls; Africans eat fish but not bread, pizza, or corn, because they don't have stores; tigers—tiger hamburgers.

First grade: In deserts they eat sorts of meat that we don't eat; in China they eat China food and in Africa they eat meat like cheetahs; the Chinese eat rice, but with chopsticks; in China they eat cooked slugs; in North America (Alaska?) they eat snow; if they don't have any food, they could eat snow; in China they eat things like Chinese rice and chicken and broccoli, but not sandwiches; in China they have cashew chicken and sweet and sour chicken; in Texas and Mexico they eat Mexican food—tacos and fries with cheese.

Second grade: In China they have noodles; most people don't eat different foods than we do, just different types—different kinds of breads, different kinds of rice; my dad and brother went to Mexico and they had to eat like killed animals and stuff like that—fish, sea creatures, crabs; in one country they have this kind of taco that you eat with chopsticks; in the rain forest people just eat plants and coconuts or fruits—we eat fruits too, but they eat them without cleaning them; in Japan they eat fish with rice on it, like with different greases for lunch at their schools, and in China they use chopsticks and eat Chinese food, probably like rice covered in some greases or something; in Texas they have more bars than we do, so they probably eat some kind of bar food; in Holland they eat different kinds of fish and different kinds of macaroni and cheese and spaghetti, but they don't have the same kind of applesauce or peanut butter (this student had Dutch cousins and had visited Holland the previous year).

Third grade: The French eat a lot of apples and cheese and Italy has Italian food but we have manufactured food that we don't ship; in France they eat long bread but here we eat monkey bread (made from dough rolled in cinnamon and sugar) and poppers stuffed with cheese; Chinese eat like pork ribs and rice with those weird kinds of tools that they eat their food with, and in other places they eat mutton; in China they eat fried squid, octopus, and blue whale, and here we eat turkey, eggplant, spinach, and deer; in China they eat Italian food

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(noodles?) using those little sticks to pick up their food with; there's a place where people eat spiders; some people eat octopus and frog legs; in Italy they eat a lot of spaghetti and fettuccini; different places have different foods, vegetables, or desserts and stuff because they have different tastes and maybe some stuff doesn't grow there (rare reference to geography); in China they eat lots of different things that we don't eat, like parts of animals that we don't eat today, and in Africa they have this soup called peanut butter soup that I tried in first grade but I didn't like it; in Canada (thinking of China?) they eat raw fish and pick up their food with chopsticks; they might not have gumbo in other countries, Africa might not have pizza and I don't know if they have chocolate over there or not, and I don't think they have macaroni and cheese like in the Middle East, Europe, and Russia.

Once again, the same high-achieving third grade girl is quoted at length: "In China they eat rice that's all clumped up so they can eat it with chopsticks. In Africa they don't eat meat, they find tropical food and stuff. In France and Mexico they eat a lot of different things that taste awfully good, normally things that have meat in them. (What do we eat that people in other countries don't eat?) Hot dogs, hamburgers, and ketchup."

Question 7

Kindergarten: Noodles; macaroni (meaning Japanese noodles); the Japanese eat Chinese food and seals' food (fish?).

First grade: They eat cows and we eat corn, peanut butter and jelly, pizza, chicken patties, and peas; buffalo; cantaloupe; Chinese cookies; something that looks like a ball of fruit--musk melon, that's it; they eat pizza and salad; they don't eat salad or any kind of crackers; people in Japan eat Chinese cookies, but they don't eat crackers like Americans do.

Second grade: They eat the same foods but different kinds—different rice, different bread, eggs, fruits; they eat little green stuff that looks like seaweed, with little white onions in it, and they also eat smashed up peaches—I saw that on TV . . . they don't eat pizza, ice cream, cookies, candy bars, Popsicles, Doritos, or French onion soup; they eat a salad that looks like a taco and they use sticks to eat it or use their hands; tortillas; we don't eat with numchucks (sic) and they don't eat ice cream, Popsicle sticks, or macaroni.

The following response was unusual in many respects, but especially in its detailed attention to geography and its relationships to crops: "They eat fish with rice on it, with different greases. They probably eat a lot of fish because Japan is a small area in the ocean and people by the waters probably go fishing a lot, and they probably made rice from grains, so that's probably why they eat a lot of fish and rice there . . . they probably didn't know how to make spaghetti and I don't think there's a lot of harvesting there, so there probably aren't very many pumpkins or gourds and they don't have many fruits, probably not grapes or anything like that. It's too warm there to grow these things. And another thing—when we are awake, they are sleeping."

Third grade: They eat a lot of Chinese foods; mud (couldn't explain); curry and fondue or something like that; they eat like bowls with coconut bowls and stuff, coconut food, and they could have crab because there's lots of sand; jello-ey stuff (tofu); pork rinds; squid and bat, but not deer, moose, or elk; octopus, rice balls; rice, vegetables, and turkey; they eat spicier stuff and make different foods; they eat parts of animals that we don't eat, like brains and things—it's probably like spaghetti to them; egg rolls and chicken with this weird sauce on it (one of many chauvinistic responses).

Discussion

Given the remarkable cultural diffusion that has occurred in recent years, national contrasts in diets and eating patterns are much less clear-cut than they used to be (especially for industrialized countries). Even so, certain foods are associated with certain countries and emphasized in the meals consumed there. Other foods, although available (perhaps mostly if not entirely via import), are considered foreign by the country's residents and seldom eaten there. Thus, it is still possible to make relative, if not absolute, comparisons.

When asked to compare American food with food eaten in other countries, only small minorities of the students were able to do so, either in terms of identifying foods that we commonly eat that are not commonly eaten in other countries or identifying foods commonly eaten in other countries that are not as commonly eaten here. Most examples of foreign foods were Mexican, Italian, or Chinese. An interesting feature of many responses that focused on comparison with Asian foods was inclusion of spaghetti and meat balls, macaroni and cheese, or pizza as typical American fare. This occasionally occurred for Mexican food or French fries as well. These responses are accurate: Certain foods originally considered ethnic are now so commonly eaten in the United States that it makes sense to talk of them as American foods.

A common response was that Americans eat candy and other processed foods or traditional family meal foods but Japanese people eat rice, fish, etc. A common mistake was to name fruits and vegetables as foods that the Japanese people do not eat. This question was difficult for students because there is no common stereotype of Japanese food (unlike, for example, Chinese, Mexican, or Italian food).

Coding categories that reflected the more sophisticated responses to Questions 6 and 7 showed positive relationships with grade level (and to a lesser extent, achievement level),

whereas the categories for less sophisticated responses showed no significant relationships or significant negative relationships.

Only about 40 of the students were able to speak knowledgeably to these two questions, and these students found it easier to talk about foods eaten commonly in other countries but not in the United States than to talk about foods eaten commonly in the United States but not in other countries. This is understandable given that the students were American children with little or no direct experience with life in other countries. The one student who had spent some time with relatives in Holland spoke knowledgeably and at some length about similarities and differences in foods eaten in the two countries.

Elements of chauvinism appeared in some of the responses, most notably those of students who spoke of people in other countries eating what Americans would regard as exotic foods. Even when speaking of less exotic foods, students occasionally made it clear that they viewed American practices as not merely different but more appropriate than their counterparts in other countries, such as when referring to "weird" sauce or tendencies to eat raw rather than cooked fish. In responding to all of our interviews, children common display chauvinism when drawing comparisons with other countries or cultures (as well as presentism when drawing comparisons with people or practices of the past). One major implication for curriculum and instruction is to make sure that what is taught about people in the past or in other cultures is presented in ways that encourage the students to empathize with the people being studied and to see their customs as intelligent adaptations to time and place (rather than as stupid, weird, etc.).

Origins of Foods Brought to America

Nineteen ninety-two marked the quincentennial of Christopher Columbus's first voyage to the Americas. This anniversary stimulated scholarly activity on what at first was called the Columbian Exchange but later simply the Encounter: the diffusion that occurred when previously isolated people and cultures met and began influencing each other. The National Council for the Social Studies (1992), as well as independent scholars (Davis & Hawke, 1992; Wooster, 1992) published guidelines for teaching about the Encounter, and these typically included information about crops or foods introduced to America from Europe (and vice versa). We wondered if students interviewed just a few years after this quincentennial-generated flurry of interest in the Encounter would display any evidence of exposure to it (we realized that such evidence would be more likely in fifth graders or older students studying history, but we also knew that children in the early grades often get some exposure to the Encounter in connection with teaching about Columbus Day). More generally, we were interested in what children might know or think about the introduction of crops, foods, or specific dishes originating elsewhere into the American diet. Question 8 was included to address this topic:

Question 8: Some foods that we eat now were brought here to America by people who came from other countries. What are some of these foods that were brought here from other countries?

Thirty students were unable to respond to this question. Of those who were able to respond, a majority answered incorrectly by naming generic or common foods such as fruit, meat, milk, or apples (31), or identified crops or foods as originating elsewhere that actually originated in the Americas, such as corn, tomatoes, turkey, or pumpkins (18). In addition or instead, however, 33 students generated responses that we considered accurate. These included

22 references to specific dishes originating in other countries (crab Rangoon, tacos, spaghetti, goulash, etc.) and 17 references to crops originating elsewhere (rice, bananas, etc.). Most of the responses referred to diffusion that occurred much more recently than the Encounter (e.g., introduction of Italian, Mexican, or Asian foods in recent decades). No student referred to Columbus or the Encounter, although a few referred to the Pilgrims or other early English colonists. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

China. Holland, I think.

Kate

[no response]

First Grade

Chris

Turkey. (OK. Where did it come from?) The Pilgrims. I forgot what country they were from.

Lauren

[long pause] I don't know.

Second Grade

Mark

Grain, vegetables, meat. (When you say grain and vegetables and meat, what particular sorts of vegetables are you talking about?) Like corn, green beans, and meat like hot dogs and hamburger. (So they came here from other countries. Do you know which other countries?) It's where the Pilgrims came from, I think.

Emily

Fruit. Some fruit came from the rain forest. Some other fruits came from jungles. Coconuts came from the rain forest or the jungle. Chicken fried rice probably came from Japan. Fish came from the ocean or lake or sea.

Third Grade

Dale

Hm . . . (Can you think of any?) No.

Chelsea

Turkey. [very long pause, no further response]

Grade Level Differences

All six of the categories for Question 8 showed significant relationships with grade level, although one of these was nonlinear. Younger students more often failed to respond to the question and older students gave more of the accurate responses as well as more incorrect nominations of crops or foods that actually originated in the Americas. The nonlinear relationship was for mentioning generic or common foods, which occurred more frequently among second graders than other students.

Achievement Level and Gender Differences

There were three significant relationships with achievement level but none with gender for the categories of responses to Question 8. Higher achievers were more able than other students to respond to the question, as well as more likely to identify specific foods brought to America from other countries.

Relationships Among Response Categories

Students who named generic or common foods were more likely than other students to also name crops or foods of the Americas. Many of these were students who responded to Question 8 by rattling off a list of foods, with most if not all of these guesses being incorrect.

The categories that included the best answers to the question (Categories 4, 5, and 6) all correlated with the maturity set of sophisticated responses to the interview as a whole, including responding to Question 6 by identifying specific foods conventionally associated with other countries, knowing details about the processes involved in making bread, and understanding the role of machines in making farming more efficient.

Rare and Unique Responses

The following responses to Question 8 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Kindergarten: Milk.

First grade: Chinese people brought Chinese food; rice and other Chinese food from the Chinese; rice and Chinese tacos; the Pilgrims brought turkey; bananas; peanuts; candy, apples, chocolate, and bananas; chicken; crab Rangoon from China; tacos and fries with cheese from Mexico.

Second grade: Pineapples, oranges, apples, grapes, tomatoes; squid; corn, green beans, and meat like hot dogs and hamburgers came from the country that the Pilgrims came from; coconuts and mangoes; pasta; pizza and spaghetti; some fruit came from the rain forest and other fruits from jungles, like coconuts, and chicken-fried rice probably came from Japan; spaghetti from Italy, fish from Japan, and English muffins; mangoes, bananas and other fruits, tortillas; Japanese noodles, fortune cookies, Chinese fish and chicken; bananas.

Third grade: A lot of our foods started out from England because the British came over here and made it into America; strawberry jam; rice, curry, and mangoes; broccoli from China; some rice and Chinese stuff and some pizza and Italian stuff; spaghetti, pizza, and goulash; octopus and Japanese rice balls; spaghetti, tacos, and fettuccini; cocoa pods and tea from South America; egg rolls, rice, chili sauce, chicken with teriyaki sauce, and pineapples soaked in sweet and sour sauce.

Discussion

When asked about foods brought here from other countries, most couldn't respond, named only generic foods, or incorrectly named foods that originated in America. However, a minority was able to name general crops or specific dishes brought from elsewhere, primarily Italy, Mexico, and Asia. This is understandable given the popularity of these foods, their ethnic images, and the fact that their names often include references to their countries of origin.

The students' responses showed no evidence of exposure to the Encounter, although a few of them showed evidence of exposure to teaching about the Pilgrims and other early English colonists. What the students did know about introduction of foods to America mostly involved experience-based knowledge about Italian, Mexican, Asian, and other ethnic foods introduced (or at least, popularized) in recent decades.

Reasons for Contrasts Between American and Chinese Diets

Our previous interviews indicated that the students typically had little knowledge or even awareness of the role of geography (climate, land forms) in explaining regional differences in the ways that people meet their needs for shelter and clothing. Questions 9 and

10 were designed to assess the degree to which the students were aware of geographic (and related economic) factors that underlie two key contrasts between American and Chinese diets:

Question 9: American people eat a lot of beef but Chinese people eat a lot of chicken. Why is that?

Question 10: American people eat a lot of bread but Chinese people eat a lot of rice. Why is that?

Only about a third of the students were able to supply substantive responses to these two questions. Twenty-eight students could not respond to Question 9. Of the rest, 14 said that American people eat a lot of beef but Chinese people eat a lot of chicken simply because they are different people, and another 35 attributed the difference to simple taste differences (Chinese people like chicken better but Americans like beef better). However, 29 students suggested differences in access: Chinese people have more access to chickens or raise more chickens, whereas Americans raise more beef/cattle. Finally, 6 students suggested that the Chinese do not know anything about beef or how to cook it.

Very similar patterns of response appeared for explanations of why Americans eat a lot of bread but Chinese people eat a lot of rice. Thirty-one students could not respond to Question 10, 14 said that this difference occurs simply because these are different people, 31 attributed the difference to taste preferences, and 33 spoke of differential access to rice vs. wheat. Question 10 gave students a little more to work with in developing explanations (rice is easier to eat with chopsticks, Americans like to spread things on their grain and bread is easier to spread things on, etc.). Even so, the pattern of results was similarly limited for both questions. In this regard, it should be noted that even the better responses were less informed than the description of the "access" categories may seem to imply: Most of these responses

were simple variations of the statement that the Chinese people have more chicken/rice and American people have more beef/wheat, made without further explanation citing geographical reasons for these differences. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

9. I don't know.

10. I don't know.

Kate

9. Because they're different people.

10. Because rice is made in Chinese.

First Grade

Chris

9. Cause they like chicken more than beef, and we like beef more than chicken. (Is there some other reason why Americans eat more beef but Chinese eat more chicken?) No.

10. Because rice is better for the chopsticks to pick up. And bread they can't pick up very good with chopsticks, and they don't even have bread where China is.

Lauren

9. We like beef better than they do.

10. They like rice a lot better. They like bread a lot better. (American people eat bread.) Yeah, that's what I mean.

Second Grade

Mark

9. Cause they might have more chicken there, and we have more beef here. (Why might that be?) I'm not sure about that.

10. We have bread—we can make bread, and rice is not like a kind of food that American people eat, and they have more rice there or something, and more bread here. (Why isn't it something that many Americans eat?) Cause usually they can't find it because they don't grow it here, I don't think.

Emily

9. I don't know. They probably think their culture likes chicken more than beef. I like chicken more than beef, too.

10. Probably because they like rice a lot.

Third Grade

Dale

9. I don't know.

10. Cause they like rice. Maybe that's the only thing they eat there. Could be they get them from trees, like if they had branches on the top. (Get what from trees?) They could get rice from trees, like little special papers to put the rice on. (Do you know how they grow rice?) Let's see. I think there's like this little plant, like a rice. I don't know the name of it, but I think it's like close to a pond and ducks can eat it, and you would probably smell the scent of it.

Chelsea

9. Cause they can't find much beef around where they live. (Why might that be?) [very long pause, no response]

10. Because in another country they need iron. [couldn't explain]

Grade Level Differences

Analyses for both Questions 9 and 10 showed that more younger students were unable to answer the questions and more older students supplied accurate (as far as they went) responses that referred to differential access to chicken/rice vs. beef/wheat. There were no significant grade level trends for the other responses.

Achievement Level and Gender Differences

The categories for responses to Questions 9 and 10 showed only one significant relationship with achievement level, and none with gender. Higher achievers were more likely than other students to make the most sophisticated response to Question 9 (Chinese people have more access to chickens, Americans to beef).

Relationships Among Response Categories

Parallel categories for coding responses to Questions 9 and 10 all showed significant correlations. That is, students who were unable to respond to Question 9 also were more likely than other students to be unable to respond to Question 10, students who answered "because they are different people" to Question 9 were more likely to give this answer to Question 10 as well, students who attributed the differences to taste in responding to Question 9 tended to do the same in responding to Question 10, and students who made "access" responses to Question 9 tended to do so in responding to Question 10 as well. Students who gave "access" responses also were more likely than other students to be coded in the maturity set categories for other questions. Finally, students who mentioned differential access to the two meats addressed in Question 9 were more likely than other students to mention meat in responding to a later question about products that we get from sheep, and students who referred to differential access to rice vs. wheat in responding to Question 10 were more likely than other students to list specific foods associated with China and other countries in responding to Question 6, to know more of the steps involved in making bread, and to know that chicken farmers raise their chickens primarily to sell them for profit.

Rare and Unique Responses

The following responses to Questions 9 and 10 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Kindergarten: None.

First grade: We have more beefy animals; the Chinese are used to chicken and I don't think they have had beef very much—some people have never heard of it because no one has told them about it yet; maybe they have more chickens in China so maybe they have more eggs there, and maybe they don't have what beef comes from—cows.

Second grade: They're from a different culture and discovered different foods; it could have something to do with their religion, or maybe they just don't care for it as much as we do, or maybe they don't know how to cook it—maybe they don't have stoves or microwaves; they might not have the same animals, because of their surroundings (couldn't elaborate further); I guess that things made out of beef live here and things made out of chicken live over there (this student later showed herself to be unclear about where hamburger meat comes from).

Third grade: Maybe that's where chickens like to live and this is where pigs like to live (note that this student not only identifies pigs as the source of beef but attributes the national difference in diet to animal rather than human preferences); maybe they don't know what beef is because they just have chicken there; because they don't have food stores that sell beef; because the Chinese have less money. The last two third-grade examples are quoted in more detail:

"We have more cows here because there aren't many fresh fields in China, so cows couldn't live there because they need a lot of fresh grass to eat. I think they eat 18 hours a day or something like that. In China it's usually always hot weather and it's harder for the grass to stay fresh." (This student clearly understood the role of geography, even though her explanation was not completely correct.)

"Maybe they don't have as many cows and pigs or other animals that give meat like we do . . . maybe because the pigs don't have a lot of mud, or they just can't cook the different kinds of meat . . . cows need a lot of grass and they need to have freedom and not be all squished together by a fence or pen or whatever. They need to be able to go out there and feed. Also, cows are heavy, so how would they get all of that meat all the way from here to China. Maybe there are animal planes where you just put an animal on the plane, like a cow, and fly it over there." (This student also displayed an intuitive understanding of the role of geography, although her explanation also is problematic. In addition, she thinks of meat export only in terms of transporting live animals, rather than packaged and frozen cuts of meat.)

Question 10

Kindergarten: None.

First Grade: They probably don't have bread because they don't have dough or cows, because milk helps bread get made, and they probably don't have ovens; you can pick up rice good with chopsticks, but not bread (note reverse reasoning: the Chinese prefer food that they can eat with chopsticks, rather than that the Chinese invented chopsticks because they are suitable for eating the foods that they eat); they've never had bread because they've never come here to try it; we have more wheat grains and the Chinese people have more rice grains, maybe because they have more seeds for rice over there.

Second grade: I don't think rice grows here; rice grows better over there; the Chinese prefer eating rice (with chopsticks) because they don't want people to get sick from passing germs by handling the food with their hands; maybe they don't have yeast and rice can be cooked with heat, and maybe it's easier for them to heat things than to get yeast for it, and also they can use chopsticks which are more common in China than here; the Chinese don't have knives to spread butter on anything because they have those chopsticks, so they don't eat a lot of bread [reversed reasoning].

Third grade: It's easier to grow rice there; they like rice and they don't have bread because they don't have wheat fields; they don't have any bread, can't make any bread, don't have stuff for bread, because they don't know what bread is; maybe they don't have the stuff to make bread, they might not grow stuff like wheat, because they don't have room. The last three third grade responses are quoted in more detail:

"There are more rice fields in China but more wheat fields in America. I think it's because of the amount of rain and farmers and we have something in America called the Great Plains where half our grains grow. In China some farmers just grow little rice fields."

"Maybe they don't have a lot of clear places where they can grow grains that bread is made of. Or, maybe they just say, "Hey, we eat rice. We don't want to go over there and buy some bread or cereal."

"We're different cultures and they eat stuff that they can raise well over there and we eat what we can raise well over here. (What determines what we can raise?) How our weather is. Like if it's sunny, you can raise tropical things."

Discussion

Some of the rare and unique responses, particularly by older students responding to Question 10, showed clear awareness of the role of geography (and in some cases, a modicum of specific information about some of the processes through which geography exerts its effects). However, it should be kept in mind that the geographical references quoted or paraphrased in the section on rare and unique responses were the only such references elicited from the 96 students, and that even these often were accompanied by confused or incorrect statements about why the geographical differences between the two countries would lead to differences in food production patterns.

It also is noteworthy that the students were much more aware of the role of geography in influencing crop farming than animal ranching. Only four students made clear references to geography in talking about the contrast in chicken vs. cattle raising, and only two of these suggested possible explanations. In contrast, nine students alluded to geographical influences on rice vs. wheat production, and several of these suggested explanations. We wonder if this difference reflected the effects of science units on plants that included experimentation with environmental conditions (e.g., exposure to sunlight) that affect plant growth. Units on plants are often included in primary-grade science teaching.

The majority of the students apparently lacked awareness of the role of geography in influencing regional crop- and animal raising patterns (let alone specific knowledge of the causal mechanisms involved). Consequently, they were unable to explain Chinese vs. American contrasts in diet, attributed them simply to taste differences, or invoked unexplained differences in access to the foods involved.

Raw Vs. Cooked Foods

Questions 11 and 12 probed students' knowledge about why we cook certain foods but eat other foods raw:

Question 11: We eat some vegetables raw, but we cook meats and many vegetables before we eat them. Why do we cook these foods?

Question 12: We eat many vegetables and most fruits raw. Why don't we cook these foods?

All but nine of the students were able to provide a substantive response to Question 11 that went beyond an unexplained "for health" statement. The most popular response was that we cook foods so that they will taste better (55). Other common responses included that we cook foods so that they will be warm or hot when we eat them (39), so that eating the foods will not make us sick (26), or simply to soften the foods so that they will be easier to eat or will not hurt our teeth (24).

Thirteen students were unable to respond to Question 12. The other 83 students provided responses that were spread across seven categories: Foods that we don't cook taste good already and cooking will only make them taste bad (29), these foods just don't need to be cooked (24), cooking will change them in some undesirable way (make them gross, yucky, too hot, burned, melted, stale) (21), they simply are not supposed to be cooked (20), their current state is already good (18), people don't want to cook them because they prefer them raw (9), or eating them cooked could make people sick (6). The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

11. To eat. (Yeah, but why? Why don't we just eat it raw, like a dog does?) Cause dogs it eat raw, and people eat it their way. (But why?) I don't know.

12. What foods? (Well, we don't cook bananas. Why not?) Cause you can eat them when you first eat . . . You wouldn't want to cook bananas. (Why not?) Cause then they would be all gross and yucky.

Kate

11. Because they're raw before we eat them. (But why do we cook them? Why can't we eat them raw?) Because it would taste yucky! (Are there other reasons?) No. (How does cooking make these foods better for us to eat?) I don't know.

12. Because it comes from a different country. (Why does that make a difference?) I don't know.

First Grade

Chris

11. Because it will taste gross if it's raw. (Why?) Because it wouldn't have no taste to it and also it would be cold or warm. It has to be hot.

12. Because they're not supposed to be cooked.

Lauren

11. So they're warm and hot and soft and stuff.

12. Because they want them to be raw.

Second Grade

Mark

11. Cause if you eat them raw, sometimes you can get sick from them. (Are there other reasons for cooking these foods?) Sometimes if they're frozen and you bite on it, you could lose a tooth or something—permanent. (You said if we didn't cook them, we might get sick. Why is that? What does cooking do to food?) It's soft . . . I'm not that sure.

12. You don't need to cook them because sometimes you can eat them just regular. (Why can we do that?) Cause they won't hurt you, cause they don't like to freeze them like meats and stuff. They don't freeze them.

Emily

11. Because they would taste nasty if they were cold. (Are there any other reasons why we cook them?) Because they would taste good when they're warm.

12. I don't know. (Why don't we cook things like bananas or grapes?) Because they would burst open and it would taste really nasty.

Third Grade

Dale

11. Cause they'll taste yucky if you eat them raw and cold. They won't taste good. (OK, so taste. Are there other reasons why we cook food or cook some foods?) Well, we cook the food to keep it hot and good, instead of eating yucky stuff, like broccoli that's cold or pie that's cold.

12. The foods? (Yeah, like grapes and bananas. Why don't we cook them?) There's no recipe on how to cook them and it won't taste good either, but we can cook like vegetables cause they'll be good instead of just cold.

Chelsea

11. (pause) You cook them because . . . so we can be strong instead of not strong, and if you don't cook them, they're not healthy for you.

12. Because you don't have to when they're already healthy for us.

Grade Level Differences

For each of these questions, more of the younger students were unable to respond and more of the older students supplied substantive responses. Older students were more likely to answer Question 11 by saying that cooking foods makes them taste better or kills germs or bacteria so that they won't make you sick. Older students also were more likely to answer

Question 12 by saying that the foods that we eat raw taste good already and cooking will only make them taste bad. There was a nonlinear relationship with grade level for stating that certain foods are already good and therefore do not need to be cooked. This statement was more common among kindergarteners and especially third graders than among first or second graders.

One could argue that Categories 3, 4, and 6 are all basically equivalent—low-level responses indicating that certain foods do not need to be cooked but not explaining why not except to say that they are fine as they are. If these categories were combined, the combined category would have been coded for 14 kindergarteners, 12 first graders, 16 second graders, and 20 third graders, suggesting a rising trend of borderline statistical significance. In general, the categories for responses to Questions 11 and 12 were not as clearly related to grade level as the categories for most other questions.

Achievement Level and Gender Differences

The categories for responses to Questions 11 and 12 showed four significant relationships with achievement level but none with gender. Lower achievers were more likely to be unable to respond to Question 12, whereas higher achievers were more likely to make "other" responses that did not fit into subsequent categories, to say that the foods we don't cook taste good already or that cooking will only make them taste bad, or to say that the current state of these foods is already good so there is no need to cook them. Thus, the achievement level trends for responses to Question 12 paralleled the grade level trends, although the same was not true for responses to Question 11.

Relationships Among Response Categories

Students who responded to Question 11 by saying that we cook some foods so that they will taste better or who responded to Question 12 by saying that we leave some foods uncooked because they taste good already and cooking will only make them taste bad were more likely than other students to be coded in the maturity set of categories for responses to the interview as a whole. Otherwise, intercorrelations involving categories for Questions 11 and 12 were unremarkable.

Rare and Unique Responses

The following responses to Questions 11 and 12 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Kindergarten: Cooking makes the food look better; it makes them look better, like meat; we cook them because otherwise you might get poison in yourself and have to go to the hospital.

First grade: Some foods need to be cooked because if you ate them without cooking them, there would be no such things as stoves and electric; some stuff has germs that get burned when you cook it; because there are germs in them and it will kill them—germs die really fast when they're cooked; you can get sick if you eat meat raw, except for ham (apparently doesn't realize that ham is precooked).

Second grade: We cook them so we don't choke on raw stuff, because we can't chew it that good; some foods have bacteria in them and you need to cook them to get the bacteria

off—it kills the germs by burning them; meat has blood in it and you don't want to eat that because it would be bad for you—cooking sort of evaporates the blood in water; on days when somebody has a cold, they don't want to eat cold stuff—they want warm stuff; you have to cook meat because there are minerals in it that, when you cook them, they come off and you can eat it.

Third grade: Certain foods have like diseases on them, like dirt on them, and when we cook it we usually wash it or fry the things that could hurt us off; hamburgers need to be cooked—if you ate them raw, you'd get blood and you don't want other animals' blood because it can make you sick . . . heating it up pressures the blood out; we cook the foods so we don't get germs and get sick—if we burn the food, the germs die because of the heat radiation; cooking gets the poison out of them so we don't get sick; they might have germs and stuff on it; we have to get the eyeballs and the butts out and not eat it raw because it would taste gross and it's cold and it might make you sick or something.

"Foods like meat, you can't eat them raw because there's stuff in them that could make a human sick. Cooking takes away that stuff. I think it sort of falls off because of the hotness from the stove or the oven." (This and several other responses pictured the "bad stuff" as being "on" the meat—sitting on the outside like a cover—rather than sprinkled throughout it.)

"Lots of people think that foods taste better when they're cooked. (How does cooking make them taste better?) It doesn't really, all it does it add grease and fat. Cooking some things like French fries, it adds grease and fat, but cooking beef doesn't do anything but make it warm and it tastes better. Cooking carrots, I don't know why in the world they cook carrots."

Discussion

Most students described cooking as softening foods or making them taste better. We were surprised that more students did not mention killing germs or bacteria. In retrospect, we should have asked specifically about meats instead of mentioning both meats and vegetables for Question 11, because some students were thinking about meats and others thinking about vegetables in responding to the question. With vegetables there usually is no health risk involved in eating them raw, so the reasons for cooking them do simply have to do with softening them and making them taste better. Even so, it is noteworthy that none of the students mentioned seasonings or other ingredients that enhance or add flavor when they talked about cooking.

The responses were generally accurate as far as they went, although they usually did not include communication of scientific knowledge or terminology. There were occasional tendencies toward reversed logic (the existence of stoves proves the need to cook certain foods) or minor misconceptions (ham is eaten raw, the major reason for cooking is to prevent choking, animal blood is bad for you, people with colds shouldn't eat cold food, the "bad stuff" is on the outside of the meat rather than dispersed throughout it, cooking certain foods could make you sick). Relationships to grade level were fewer and weaker for this set of categories than for most other sets, although the better responses (including those that mentioned cooking meat to kill germs or bacteria) were made more frequently by older than younger students.

Refrigeration and Preservation of Foods

We asked three questions relating to food refrigeration and preservation to assess students' knowledge and thinking about why certain foods need to be refrigerated and what refrigeration or other food preservation methods do to keep the foods edible longer.

Question 13: We put many foods in the refrigerator to keep them cold. Why do we do that?

Question 14: Before electricity was discovered, people didn't have refrigerators. Where did they keep their foods then?

Question 15: Some foods keep for a long time in bottles or cans without spoiling. Why is that?

Only nine students were unable to respond to Question 13, although another 11 could only say that some foods need to be kept cold. The most popular responses came from the 52 students who said that we refrigerate certain foods to keep them fresh or to keep them from getting stale/rotten/yucky. Other common responses explained that we refrigerate certain foods to keep them tasting good (19), to keep them from melting (17), to keep them from making people sick (17), or to keep leftovers for eating later (11).

Question 14 was more difficult for the students: 26 were unable to respond and another 10 could only say that people kept food in cold places or storage places. The remaining responses included that they kept the foods in ice or ice boxes (27), in cupboards or pantries (19), or outside (18). There also were 16 "other" responses. Many of these were among the most knowledgeable, including statements that they kept foods underground, cooked them or ate them quickly before they could spoil, or covered or wrapped the food to protect it from bugs.

Question 15 was the most difficult: More than half (56) of the students were unable to respond to it. Common ideas in the remaining responses included the notion that bottles and cans are closed so that "no air" or "nothing" can get to the food (14), recognition that bottles and cans are closed coupled with inability to explain why this retards spoiling (10), and the

misconception that bottles and cans are cold or retain cold (made by 7 students who were thinking about removing cold beverages from the refrigerator). Only a few students (too few to constitute a category that could be analyzed statistically) mentioned keeping germs or bacteria away from the food. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

13. To keep them fresh. (Is there any other reason why we might keep them in the fridge?) Not that I know.

14. On the table . . . on the counter. (Can you think of anywhere else they might keep them?) In the cupboards. (How did they stop them from spoiling?) I don't know.

15. I don't know.

Kate

13. I don't know.

14. Outside. (Why did they keep them outside?) Because outside's cold sometimes. (How did they preserve foods to keep them from spoiling? How did they stop them from going rotten?) I don't know.

15. [no response]

First Grade

Chris

13. So they won't get warm or nothing and they won't get gross and all that stuff. (What's wrong with them getting warm?) Because when they get warm, they might get little white stuff on them and sometimes if you leave bread out too long, it'll turn green.

14. I don't know.

15. I don't know.

Lauren

13. I don't know.

14. I don't know.

15. Because they are supposed to be in cans instead of being in bags like how apples have bags. (Could you tell me a little more about that?) I don't know.

Second Grade

Mark

13. So they won't spoil. Keep them cold. Some foods like juices and stuff need to be cold and . . . (Are there any other reasons for refrigerating some foods?) I think there is, but I don't know.

14. Well, shady spots . . . they could put it there. They could make one out of rocks and then find something to keep it cold and put it in there.

15. Cause nothing gets to them because they're in a can. (What do you mean by nothing gets to them?) Like spoiling . . . I'm not very sure. I'm not sure.

Emily

13. Because if we warmed them up, they would all melt. (Are there any other reasons why we keep foods in the refrigerator?) Because on some foods, on the box, it says keep food in the refrigerator. (But why?) Maybe because if it gets warm, it won't taste good.

14. Cupboards and in their room. (How did they preserve foods to keep them from spoiling?) I don't know.

15. Cause if it was like water in a cup, it would just go all over and float. (Well, we can put things in bottles or cans and you open it up and it tastes just fine. Why is that?) I don't know.

Third Grade

Dale

13. So they won't spoil. (Why will the refrigerator stop them from spoiling?) Cause the heat gives the warm stuff over plastic, so you have to keep it over plastic so it won't spoil. (Why?) Because . . . because like . . . what was that question again? (We put many foods in the refrigerator to keep them cold. Why do we do that?) Cause they won't harden. Well, they'd still taste good and some of them don't need over plastic like fruits, apples, oranges. You can't use it with bananas because bananas will probably get like really yucky and stuff, and if you don't put plastic over it, it'll probably get rotten.

14. Probably out of the refrigerator. (How did they stop the food from spoiling?) Hm . . . well, they could probably use little leaves on the trees—take them off and put them over the foods so they won't spoil, and then they probably take like . . . open the coconut and put the food, then put one leaf on the bottom and put the other leaf on the top so it would stick, and then you could just put the rest of the coconut all over it so it won't spoil.

15. Because they have hard tops over it and they don't take the tops off and leave them there. It would smell bad in the store and stuff, and it'll really smell not good. So people wouldn't want to go there. (But why does it work?) Why does it work? (Yeah, If you put something in a bottle or a can, it won't spoil.) Because the smell can't get out of it. It's like a box and they taped over it and the smell can't get out of the tape. (What's the smell got to do with it?) Oh, so it won't rot or anything. (Yeah. Why?) Cause they have a hard top over it. It's like hard and stuff.

Chelsea

13. Cause we have a place to store them and they won't get rotten. (Can you think of any other reasons?) No.

14. A cabinet or a cupboard. (How did they preserve their foods to keep them from spoiling?) A cloth or something over them so they wouldn't dry out.

15. It might have a lid on it so it won't spoil. (How does that keep the food from spoiling?) I don't know.

Grade Level Differences

Most of the low-level responses to Question 13 (failures to respond and unelaborated statements that some foods need to stay cold) were made by the younger students. There were no significant grade level trends for responses focused on saving foods as leftovers, keeping

them tasting good, or keeping them from melting. However, older students were more likely than younger students to make the most popular response focusing on keeping foods fresh, as well as the response noting that refrigerating certain foods keeps them from making people sick.

For Question 14, younger students were more likely to be unable to respond to the question or to talk about people keeping their foods cold by keeping them in rivers or buckets of cold water. The negative relationship for the latter response was not surprising because most of these responses were unelaborated guesses, although a few were based on information that students had picked up about food preservation methods used by the pioneers or other early settlers. Of the remaining categories of responses to Question 14, older students were more likely than younger students to talk about keeping foods on ice or in ice boxes, to suggest that foods were kept outside (especially in the winter), or to communicate one of the primarily sophisticated "other" responses.

Concerning Question 15, more of the younger students were unable to respond and more of the other students talked about bottles and cans being closed, either without further explanation or with explanation that this keeps air or other things from getting to the food. Overall, the grade level trends for these three questions are not surprising: Younger students more often failed to respond or gave inaccurate or low-level responses, whereas older students were more likely to give correct or more mature responses.

Achievement Level and Gender Differences

The categories for responses to Questions 13, 14, and 15 yielded only two significant relationships with achievement level and two with gender. Average achievers were more likely than other students to say that we refrigerate certain foods to keep them tasting good, and low

achievers were more likely than other students to be unable to respond when asked why some foods keep for a long time in bottles or cans. Boys were more likely than girls to say that we refrigerate certain foods to keep them from making people sick and to say that before electricity was discovered, people kept their foods in storage places or cold places (without further explanation). None of these differences seems particularly noteworthy, although one could interpret the boys' more frequent mention of refrigeration to keep foods from making people sick, coupled with girls' tendency toward more frequent indication that refrigeration is to keep the foods tasting good, as evidence that boys have a little more knowledge (or at least, intuition) about the implications of food spoilage (i.e., that it doesn't merely impair taste but can create the possibility of food poisoning.

Relationships Among Response Categories

Students who responded to Question 13 merely by saying that some foods need to stay cold (without further explanation) were more likely than other students to be unable to respond or to give low-level responses to other questions. Students who said that we refrigerate foods to keep them tasting good were more likely than other students to say that we cook foods so that they will taste better. Students who said that we refrigerate foods to keep them fresh or to keep them from making us sick were more likely than other students to be coded in maturity set categories for their responses to other questions. Also, students who noted the need for refrigeration of some foods to keep them from making people sick were more likely than other students to mention cooking the meat when talking about steps in making a hamburger.

Students who answered Question 14 by saying that people kept foods on ice or in iceboxes before refrigerators were developed were more likely than other students to be coded

for the general maturity set of responses, and in particular, to say that it is too cold to grow crops in Alaska. Thus, these students appeared to have particular knowledge of or interest in cold/ice. Finally, students who said that bottles and cans are sealed so that no air/nothing can get to the food were more likely than other students to be coded for the maturity set of responses to the interview as a whole.

Rare and Unique Responses

The following responses to Questions 13-15 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 13

Kindergarten: To keep them from getting damaged, because if you drop them, you could break them, like eggs.

First grade: Because if you leave them out they might get little white stuff on them and if you leave bread out too long it will turn green [this was one of many responses that focused more on freezing than mere refrigeration]; if you didn't put them in the refrigerator, they would turn into rocks; some things aren't cold if you just put them on a shelf, and it keeps them away from bugs, too.

"So they don't get yucky and bugs don't get on them. Bugs make food yucky because they eat it. If you put it in the refrigerator, bugs can't eat it, and if some bugs do get into the refrigerator, they wouldn't eat all of it because they hate cold."

Second grade: Because that's what refrigerators were made for [reversed logic]; like if you have leftover salad, you can keep it in a nice cool spot to keep all the minerals in there and keep it nice and fresh; some foods need to be kept cold or else they get this green stuff on it.

Third grade: The refrigerator keeps them cold and puts them where germs and diseases can't get to them; some foods have to be kept with plastic over them or they will spoil; so bugs don't get into it; if you just leave them out they will rot and decay. (Any other reasons?) To make space on the counter.

"With like milk, you have to keep it cold and fresh or it will spoil and not taste good. Drinking spoiled milk could make you sick because there's things called decomposers that if they get into the milk, they can make you sick, like bacteria."

Question 14

Kindergarten: Under ground; in cupboards; in freezers (But they didn't have freezers, so what did they do?) I guess they put them in snow. (Can you think of anything else they might have done?) Put cold water on the food. [Many of the snow/cold water responses were guesses like these.]

First grade: If the foods were starting to spoil, they would cook them; maybe they would put them in a rock cave or in snow when it snowed; they kept it in plastic bags in a certain part of the house; maybe they just ate more of their food or ate it quicker before it could spoil.

Second grade: They would put it in cupboards so no bugs and stuff could get on it much; they kept it in a bag and closed it tight, or maybe put it in a cooler with ice in it; they kept it in shady spots, they could make one out of rocks and find something to keep it cold and put it there; they put it in a cooler or kept it underground; maybe they had coolers and made ice then, or maybe they had this machine that blows cold air [air conditioner]; in a big box that had ice in it; on vacation I went to an ice cave and it was really cold in there—maybe those could have been their freezers; in ice boxes (Did they have any other method of preserving foods?) They hung it up on some strings.

Third grade: They would wrap it in a sheet and put it in an icebox; they would cover it, maybe with leaves from trees; an icebox—a big giant box that looked like a refrigerator but didn't have cold air in it, it had a door and a shelf with two giant ice cubes under it; make a hole in the ground and put the food down there; maybe in a cooler or freezer, because freezers sometimes don't need electricity—sometimes when we go out and the electricity is out, the freezer is still running [apparently based on experiences in using a backup generator when the electricity is out]; they would put it in a jar or wrap it up; they put a cloth or something over it so it wouldn't dry out.

"In an icebox. There was a man that came around every week and brought ice. And they would have metal shelves and when the water would drip, there would be a tray at the bottom, and it would keep their foods cold." [Most third graders who mentioned an icebox had similarly accurate, if less complete, descriptions of it.]

Question 15

Kindergarten: None.

First grade: Because some foods don't need any oxygen [has correct idea about keeping oxygen out, but reverses the reason]; because they're liquids and might get spilled all over if we didn't have bottles or cans to keep them in [one of many responses that tells why bottles or cans are better than other containers for keeping liquids, but fails to address the issue of why the foods don't spoil.].

Second grade: Because when it's open, it spoils quicker, because it isn't sealed (But what spoils it?) The fresh air; because the bottle won't get that much bad stuff in it, the rim will stay on and it's glass (Where is the bad stuff?) In the air; because the can is closed so no bacteria can get in and it doesn't rot; they can't spoil because they got special stuff in them like a fizz

[reversed reasoning]; because if it was like water in a cup, it would just go all over and float; because if you keep the foods closed up, the germs can't get inside as easily as if it's out; maybe because like pears have pear juice in them and maybe that keeps them from spoiling.

Third grade: It's kind of like a refrigerator—it keeps foods in there where it doesn't have to get everything all over it; bottles and cans keep air out so they can't spoil—air carries germs and things like that; bottles and cans don't let a lot of air in, and air has too many chemicals that will make foods rot; there's a top on it that keeps it so nothing gross gets in it (Like what?) Like a little insect or something, dirty things; they're protected by the glass from bugs or toxic stuff; there's like no air or anything that can get into it—air can be dirty and get all over the food and turn it black and brown; because if it was open there would be bugs coming in, like spiders and air that would make it go stale; pop and stuff has fizz in it; they are airtight, so the food stays really fresh—no bacteria or things like that can get into it.

Discussion

Most of the students understood that foods eventually deteriorate (turn hard or "yucky") and that steps can be taken to preserve their freshness or edibility, although even the third graders had only limited knowledge about the decomposition processes responsible for food spoilage and the reasons why these are retarded by refrigeration or covering and sealing. None of the responses to Question 13 drew an explicit connection between temperature and decomposition/spoilage rate, and the one third grader's reference to decomposers was the only approximation to a scientific explanation that appeared in this response set. Most of the students simply asserted that some foods needed to be kept refrigerated or frozen to preserve them, and

most of those who did offer a more elaborate explanation spoke in terms of protecting the foods from bugs (meaning insects, not bacteria) rather than retarding their rates of decomposition.

The findings for Question 14 indicated that a majority of the students were unable to say anything about how people preserved foods prior to electricity or else could only make vague references to storage places. However, many of the students (especially third graders) knew about iceboxes and could even describe them in some detail. In addition, a few students made references to underground cellars or hanging of meat, although none mentioned salt or other preservation methods. A few mentioned wrapping or covering foods to protect them from insects or the air.

Lacking knowledge about decomposition, the students also had difficulty explaining why foods don't spoil in bottles or cans. Almost half couldn't respond. Some of the others knew that it was important that bottles and cans are tightly closed but could not explain why, and a few had the idea that cans retain cold because they are metal or because they retain liquid. A few made reference to the fact that certain beverages contain "fizz" and it is important to keep them tightly sealed so that they do not lose that fizz, so they reasoned from this that the fizz must be responsible for keeping the beverages from spoiling (or at least, getting stale). The best responses made reference to tight sealing to keep harmful things away from the food, but most described these harmful things as air or bugs rather than germs or bacteria.

Like most sets of responses in our interviews, this set indicates that most students had good practical knowledge (understanding that foods spoil and that steps such as refrigeration and careful wrapping or sealing can retard spoilage), based on observable features and events (foods gradually lose their freshness and become stale, hard, or "yucky"), but few understood much about the causal mechanisms underlying these transformations. Students with no knowledge

were unable to offer substantive explanations, students with beginnings of understanding spoke of protecting food from "bugs" (insects), and students who were starting to develop more scientific understanding spoke of protecting foods from germs, bacteria, or things in the air (including oxygen and air itself). However, only one student referred to decomposition and none explicitly noted that this process occurs more quickly at higher temperatures.

Characteristics of Healthful and Less Healthful Foods

Questions 16 and 17 addressed students' knowledge about healthful vs. nonhealthful foods and the reasons why these foods are classified as such.

Question 16. Certain foods are healthful and nutritious. What are some of the foods that are especially good for you? . . . Why are these foods good for you?

Question 17. Other foods—often called junk foods—are not very healthful and nutritious. What are some of these junk foods? . . . Why aren't these foods good for you?

All of the students were able to respond to the first part of Question 16 (16A), although six of them incorrectly listed one or more foods that are not considered healthful or nutritious. Among the other 90 students, 66 listed specific fruits or vegetables, 45 listed food groups or categories of food, and 37 listed specific nutritious foods other than fruits or vegetables. Even more than their answers to Question 3 on food groups, the students' answers to Question 16A displayed good knowledge of foods considered healthful.

Question 16B asked why these foods are good for us. Seventeen students were unable to respond to this part of the question. In addition, about half of the responses made by the remaining students were simply elaborations of the notion that these foods are good for us rather than explanations of why this is the case. Of these responses, 24 students said that good foods

keep you healthy, 11 that they help you grow/make you big, 11 that they are good for your heart, teeth, bones, etc., and 6 that they make you strong. The remaining responses were more substantive: These foods are good for us because they contain nutrition or "healthy stuff" (21), they contain vitamins, minerals, proteins, fiber, etc. (18), they give us energy (8), or they do not contain fats or sugars (8). Although limited, these responses are all valid as far as they go.

Responses to Question 17A paralleled those to Question 16A in that all of the students were able to respond and almost all of what they said was valid. About four-fifths (79) of the students identified candy, gum, chocolate, potato chips, and other snack foods as junk foods. Other common responses included cakes, cookies, brownies, donuts, and other baked dessert foods (25), ice cream and milkshakes (19), pop/soda (9), sugar/honey (9), and hamburgers, bacon, pizza, French fries, or other heavy fried or fatty foods (7). Even the responses lumped into the "other" category were accurate or at least not obviously inaccurate (bones, alcohol, seaweed, peanut butter and jelly, fish, butter, caffeine).

Responses to Question 17B paralleled those to Question 16B in that 16 students couldn't respond and many of the other responses elaborated the idea that junk foods are not good for you without explaining why: They might make you sick or kill you (16), they do not keep you healthy or make you strong (12), or they make you hyperactive (6). Other, more explanatory responses included the ideas that these foods are bad for you because they contain a lot of sugar (36), will rot your teeth or give you cavities (21), lack "healthy stuff" such as vitamins, proteins, or nutrients (17), or contain a lot of fat (15).

Taken together, the responses to Questions 16 and 17 indicate that the students generally were quite knowledgeable about healthful vs. less healthful foods, although less knowledgeable about the reasons for these differences. In particular, as reported by other investigators, the

students were much more aware of sugar than of fat as a potentially problematic component of one's diet. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

16. Meat, potatoes, salad. There's a lot of food. (Now why are meat and potatoes good for you—and salad—why are they good for you?) That's a good question. I don't know.

17. Marshmallows, chocolate. (Why aren't marshmallows and chocolate good for you?) Cause chocolate has bad stuff in it and so does marshmallows. Junk . . . they put junk inside of it. Why do they have to put it inside of it? (That's a good question. What does the bad stuff in marshmallows and chocolate do to you?) They'll make you throw up. (Can you think of other junk food?) Oreo cookies. Chocolate chip cookies.

Kate

16. Carrots. (Is there anything else?) Yeah, salad or apples. (Why are they good for you?) I don't know.

17. Ice cream and Popsicles and all that. (Why are they not so good for you?) Because they're cold. (So why are cold things bad for you?) I don't know. (Can you think of a few things that aren't cold that are bad for you—junk foods?) Yeah. (What can you think of?) Beer. (Beer? Beer is a junk food?) Well, it's not food, but it kind of . . . (It's not good for you?) Yeah.

First Grade

Chris

16. Chicken noodle soup, beans, rice, bread, fish . . . that's all I can think of. (Why are these foods good for you?) Cause they have nutrition in them. What do you mean by nutrition?) Nutrition is stuff that helps you grow. It's like a kind of vitamin.

17. That's like candy and peanuts and all that stuff. (Why are these foods not so good for you?) Cause they have a lot of sugar in them. Good foods don't have any sugar in them. Junk foods have a bunch of sugar in them. (What's so bad about sugar?) It could get in your teeth and rottens them instead of making you grow; it gets in your teeth and rottens them.

Lauren

16. Apples, carrots, bananas, pears. (Now why are these foods good for you?) Cause they're healthy. (What does that mean?) It keeps you alive and gives you energy and stuff.

17. Candy. (Anything else?) No. (Why is candy not so good for you?) I don't know.

Second Grade

Mark

16. Fruit, vegetables, gains, meat, dairy, and . . . that's all. (Now why are these good for you?) Cause they have protein and vitamins and calcium and all sorts of that stuff.

17. Ice cream, cookies, candy. (Why aren't these so good for you?) Cause they have sweets in them and they don't have as much vitamins and calcium and stuff like that.

Emily

16. Fruit is good for you, vegetables, bread, breakfast—like cereal. (Why are these foods good for you?) Because it gives you lots of energy.

17. Chocolate chip cookies, candy bars, chocolate chips, the gum that's not sugarless. That's all I can think of. (Why aren't these foods good for you?) Because you could get hyper and you could faint. (Why?) I don't know.

Third Grade

Dale

16. Meat, fruits, yogurt, dairies, grains. (Why are these foods especially good for you?) Cause they keep your body healthy and they can give you . . . if you don't have any medicine and you need some vitamins, like bananas, and they give you protein.

17. Sweets, candy canes, Pop tarts, Reese's. (Why are these foods not so good for you?) Cause they don't keep you in shape. It doesn't make your body good and stuff, but sometimes we do need sweets if we feel like it, but we can't have them all the time.

Chelsea

16. Meats, fruits, vegetables, and sometimes grain. (Why are these foods good for you?) Because they go into your bones and make you healthy.

17. Pop, potato chips, ice cream, I think, and I think salsa and chips, and cookies, and all kinds of different pops. (Why are these foods not good for you?) Because sometimes

they have lots of fat in them or they don't have that much health in them or anything. Like when you eat a pickle, they have lots of health in it, but when you eat potato chips, they don't have that much health in them. When you look on the label and how much stuff is in it, sometimes it says zero or zero grams, and maybe that's the stuff you might need in it.

Grade Level Differences

The only significant relationship with grade level among the responses to Question 16A appeared because first, second, and third graders were more likely than kindergarteners to mention food groups or categories of food. There were no grade level differences in mentions of specific foods. Thus, even the kindergarteners were able to name healthful foods accurately, although they were less likely to identify food groups or food categories than older students were.

Grade level analyses for responses to Question 16B indicated that more younger students were unable to respond to the question, that there were no grade level relationships for categories of responses that simply elaborated on the idea that these foods are good for you without actually explaining why, and that older students were more likely to say that healthful foods give you energy, do not have much fat or sugar content, or contain vitamins, minerals, proteins, fiber, etc. In summary, almost all of the students had valid knowledge about what foods are good for you, but the older students were much more likely than the younger ones to be able to provide some explanation for why healthful foods are healthful.

Grade-level analyses for Question 17 yielded patterns similar to those for Question 16. The only significant grade level relationship for responses to Question 17A occurred because more than 90% of the first, second, and third graders identified snack foods as junk foods, whereas only 46% of the kindergarteners did so. Concerning the explanations given in response

to Question 17B, more of the younger students were unable to respond and more of the older students said that junk foods are bad for you because they contain a lot of sugar, contain a lot of fat, or make you hyperactive. Once again, the pattern was that all of the students could identify junk foods, but the older students were much more likely than the younger ones to explain why junk foods are not good for us.

Achievement Level and Gender Differences

The categories for responses to Questions 16 and 17 yielded six significant relationships with achievement level and five with gender. Lower achievers were more likely and higher achievers less likely to say that good foods are good for us because they do not contain fats or sugars and to give "other" responses when asked to name junk foods, whereas higher achievers were more likely than lower achievers to identify baked dessert foods as junk foods and to say that junk foods are not good for you because they make you hyperactive. These relationships might have been predicted given the sophistication of the responses involved. The other two relationships with achievement level were nonlinear: Average achieving students were less likely than other students to list specific fruits or vegetables when identifying healthy foods but more likely than other students to say that good foods are good for you because they keep you healthy or make you strong.

Boys were more likely than girls to make "other" responses when asked to identify junk foods, but girls were more likely than boys to say that good foods are good for us because they keep us healthy, to identify ice cream or milk shakes as junk foods, to say that junk foods are bad for us because they do not keep us healthy or make us strong, and to say that junk foods are bad for us because they could make us sick or kill us. These differences suggest that the girls had

somewhat more knowledge than the boys about healthful vs. junk foods. Perhaps this should not be surprising, given indications that women are more health conscious than men in their eating patterns.

Relationships Among Response Categories

Students who answered Question 16A by identifying foods other than (or in addition to) fruits and vegetables were more likely than other students to speak of Americans as eating family meal food when contrasting American and Japanese diets. Surprisingly, students who listed categories of food or food groups in responding to Question 16A were no more likely than other students to have provided complete and accurate responses to Question 3 (which asked them to name food groups). However, these students were more likely than other students to be coded in the maturity set of responses to the interview as a whole.

Students who said that good foods are good for you because they keep you healthy/keep you from getting sick were more likely than other students to have answered Question 1 by saying that we need food to stay healthy and to answer Question 17B by saying that junk foods are bad for you because they do not keep you healthy. Similarly, students who said that good foods are good for you because they make you strong were more likely than other students to have answered Question 1 by saying that food provides strength to the body, students who said that good foods are good for you because they help you grow/make you big were more likely to have answered Question 1 by saying that we need food in order to grow, and students who said that good foods are good for you because they give you energy were more likely to have responded to Question 1 by saying that food provides energy or fuel to the body, to mention energy at some point in responding to the first two questions, and to say that junk foods make

you hyperactive. Students who said that good foods are good for you because they do not have fats or sugars were more likely than other students to say that a pound of cereal costs more than a pound of apples because it has sugar, marshmallows, honey, or other material added to it, and to say that junk foods are bad for you because they contain a lot of sugar. Students who said that good foods are good for you because they contain a lot of vitamins, minerals, proteins, etc. were more likely than other students to have said that food differs from nonfood because it contains vitamins, minerals, etc., as well as to be coded for the maturity set of responses to the interview as a whole.

Students who said that junk foods are bad for you because they contain a lot of sugar were more likely than other students to identify several food groups in responding to Question 3, to know that cheese is made from milk, and to provide more mature responses to the interview as a whole. The latter also was true of students who said that junk foods are bad for you because they contain a lot of fat or make you hyperactive.

Rare and Unique Responses

The following responses to Questions 16 and 17 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 16A

Kindergarten: None

First grade: Pumpkin pie; butter; jam.

Second grade: Wine; ice cream.

Third grade: Ice cream.

Question 16B

Kindergarten: Apples keep the doctor away, and if we don't eat healthy foods, we have to go to the doctor to get healthy; water cleans the body and milk helps us get our bones straight.

First grade: These foods help owies [good food promotes healing of cuts and bruises]; names several fruits as good for you because "they're made from the ground, from like seeds."

Another first grader said that carrots, meats, and eggs are good for you because "if they weren't good for you, they wouldn't be invented." In addition to the misconception that all inventions are good for us, this response is an example of the teleological thinking that is common in children—the tendency to assume that everything that exists has been designed to fulfill some function (Kelemen, 1999).

Second grade: Good foods help your heart to keep pumping and your brain to keep sending messages and stuff.

Third grade: These foods don't have a lot of fat in them, or meat [one of a few students who viewed meat as unhealthy]; carrots can make you see farther away and help you see in the dark; carrots make healthier eyes and apples help with your teeth and give you energy; apples, pears, and bananas are good for you "because God made them and He makes healthy food."

Question 17A

Most of the few rare and unique responses to this question were included in the examples for the "other" category: worms, bones, alcohol, beer, seaweed, peanut butter and jelly, fish [concerned about poison], butter, and caffeine. Some of these are nonfoods rather than unhealthful foods.

Question 17B

Kindergarten: Chocolate has bad stuff in it and so does marshmallows—they put junk inside of it [thinks of these foods as basically sound except for "junk" injected into them]; ice cream and Popsicles are bad for you because they are cold [couldn't explain further].

First grade: Gum, but there's some good gum that helps you when you gotta brush your teeth.

Second grade: Sugar makes your heart not go very strong and your brain not go very strong; too many carrots can make your skin turn orange; fat can clog up your arteries; candy and chocolate can make your teeth "kind of little."

Third grade: Potato chips and cookies contain a lot of grease that isn't healthy, and oils, sugars, fats, calories; caffeine makes your heart pump faster and sugar makes you wild; junk foods are not good for you because they "don't have any healthiness in them and people make them" [one of several responses to imply that natural foods taken directly from the ground are good for you but manufactured and packaged foods are not]; it makes you really jumpy if you eat too much sugar—I think that's why they made Halloween on a Friday for school.

Discussion

Most of the students displayed good basic knowledge about healthful vs. junk foods, although their abilities to explain the reasons for the difference were nonexistent or limited. The general patterns in these responses square well with patterns reported by Michela and Contento (1984), Driver et al. (1994), and other investigators, although they underscore the likelihood that students are much more attuned to potential problems with sugars than with fats. Even the youngest understood that fruits and vegetables are better for you than snack foods and desserts.

A few minor misconceptions appeared (carrots make you see better in the dark, ice cream is bad for you because it's cold, natural foods are always better for you than manufactured or

processed foods), and a few unusually knowledgeable statements were made (fat can clog your arteries, cookies and potato chips contain a lot of unhealthful grease, oils, sugars, fats, and calories). Overall, however, the patterns of response to Questions 16 and 17 featured accurate knowledge about healthful vs. junk foods but nonexistent or very limited abilities to explain the reasons for the difference. Even the third graders did not yet possess enough knowledge about body metabolism to be able to say much about why good foods are good for us or junk foods are bad for us.

Land-to-Hand Relationships in Producing Common Foods

Questions 18-21 addressed students' knowledge about the origins of common foods and the processes involved in bringing them to the table in ready-to-eat form. The questions progressed from simpler to more complicated foods, in terms of the degree to which they are transformed from their original physical state, combined with other ingredients, or subjected to cooking or other processing.

Question 18. Let's talk about how we get different foods. We'll start with applesauce. How is applesauce made?

Question 19. How is cheese made?

Question 20. How is bread made?

Question 21. How is the meat in a hamburger made? . . . Where does this meat come from? . . . What is the process of making the hamburger patty?

Only eight students were unable to respond to Question 18, although another six simply said that you need apples without being able to explain further. Most of the rest of the students said that you make applesauce by crushing, mushing, or stirring apples. Other steps in the

process, mentioned by minorities of students, included cutting up the apples (16), removing the peel, core, or seeds (22), cooking the apples (21), adding sugar, water, cinnamon, sauce, butter, or other ingredients (21), using a mixer, blender, crushing machine, or other appliance in the process (19), and storing the applesauce in a container or refrigerator after it is made (20). Given that apples go through relatively little transformation or combination with other ingredients in the process of making applesauce, we expected and found the students to be well informed about land-to-hand relationships (although it is noteworthy that only 21 of them noted that the apples are cooked).

In contrast, the students were much less informed about the manufacture of cheese. Almost half (46) of them were unable to respond, and another 40 could only say that cheese is made from milk. Only 10 students added something to the latter idea (e.g., that the milk has to be stirred or mixed or that the mixture needs to be pressed into the desired cheese shape), and only a few even approximated a land-to-hand explanation.

Explanations for how bread is made were somewhat better, although even here 30 students were unable to respond and another 16 could only say that it is made from dough. Of the remaining students, 41 said that bread is made from wheat, corn, or other grain, 12 that the wheat has to be ground, 28 that dough is made by mixing flour, milk, and other common bread ingredients, 28 that the dough must be baked, and 9 that the bread can be made in a breadmaker or other machine. Among the students who supplied one or more of these substantive responses, only 21 provided a good explanation that included both (1) making dough from its ingredients, and (2) baking the dough into bread, and only a few of these understood that flour is finely ground wheat.

Regarding hamburger patties, 39 students were unable to respond to the question about their origins, 18 said that they came from animals other than cows, and 39 said that they come from cows/cattle. Given the emergence in recent years of various substitutes for beef in "hamburger patties", at least some of the responses naming animals other than cows could be considered correct. However, a few students did communicate the expected misconception that hamburgers are made from ham.

Concerning the process of making the meat into a hamburger patty, 36 students were unable to respond but the rest identified steps that included killing the animal (34), cutting up the animal or taking the meat off of it (34), frying, grilling, or otherwise cooking the meat (26), and shaping the meat into patties (10). A major omission, mentioned by only four students, was grinding the meat.

Looking across this set of questions, it is clear that the students knew much more about operations that they probably observed at home (making bread or hamburgers) than processes that occur elsewhere (manufacturing cheese, grinding beef into hamburger meat). Also as expected, they were better informed about land-to-hand relationships that involve fewer transformations of the physical appearance of the original foods, fewer combinations with other ingredients, and less processing. Surprisingly little mention was made of cooking the apples used to make apple sauce, making and then baking dough as the basic steps in manufacturing bread, or using ground meat to make hamburgers. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

18. You have some sauce and some apples. (How do you get them?) By seeds.

19. I don't know.

20. I don't know.

21. I don't know about that.

Kate

18. From apples. (What do you do to the apples?) You crunch the inside up—really mash it up.

19. You sit the melted cheese in the refrigerator for a really long time and let the cheese freeze. (Where does cheese come from?) I don't know.

20. I don't know.

21. From a cow or something. (How does it get from the cow to the hamburger?) I don't know.

First Grade

Chris

18. They're made out of apples, and you get this pot and you put the apples . . . you peel off the skin and put them in this water and put in a jar of applesauce. That's how it's made.

19. There's this cheese store and these guys . . . I don't know.
20. It's made out of white milk. (White milk and what else?) That's all.

21. You've got two breads—one on the bottom, one on the top, and you have lettuce inside, any kind you want inside. That's how they're made. (How is the meat made?) It's made out of chicken and it turns into meat.

Lauren

18. Crushed apples. (Then what do you do?) I don't know.

19. I don't know.

20. I don't know.

21. I don't know.

Second Grade

Mark

18. You crush up apples and you get little pieces of them and put them in there and mix it up.

19. [no response]

20. It's made out of vitamins and minerals and milk. (What do they do? How is it made?) They put it in a cooking pan and cook it somehow.

21. From a pig. (What do they do to the pig to get it to the hamburger?) They cut it up and then they put it in a little plastic thing and then you take it home and cook it.

Emily

18. It's out of apples. You take the apple peeling off and then you smish the inside of the apple and then you put it in a jar, and that's applesauce.

19. I don't really know how cheese is made. (What's it made from?) Eggs.

20. Out of wheat and stuff. They put it in a bread baker, then they take it out and slice it up and then they put it in a bag.

21. Some of them are made out of cows. (How do you get from cows to hamburger meat?) I don't really know. I'll have to ask my grandpa. He works on a farm.

Third Grade

Dale

18. It's made by machines. You pick the apples just before you put it in the machines.

19. It's made from milk and the milk's put into a machine. (What does the machine do?) I don't know.

20. It's made by wheat and the wheat comes from farmers, and they put the wheat into a machine and it turns into flour, and then they put the flour in a machine and lots of other stuff—water and . . . I don't know what else.

21. The kill a pig and then they take the meat from the pig and cook it and then they put it in a bun.

Chelsea

18. By apples and apple juice is made by apples. (What do you do to the apples to get applesauce?) I think you have to grind them a whole bunch and then you have to mix it and then it becomes applesauce.

19. I don't know.

20. I think it's made by a potato or something. I'm not sure.

21. By a cow, and when you kill the cow, sometimes you can skin it and get the meat from inside it, and then when you get the meat from inside it, you could like pick it up and put it in one of them meat holders and then you could ship it off and then you could take it home and make it into hamburgers.

Grade Level Differences

Younger students were less able than older students to respond to each of these questions. All of the other significant relationships with grade level were positive ones indicating that the older students were more likely to respond by providing accurate information. Concerning applesauce, they were more likely to speak of crushing, mushing, or stirring the apples, cooking them, and using an appliance in the process (there was no significant grade level relationship for adding sugar, water, cinnamon, or other ingredients). Concerning cheese, they were more likely to say that cheese is made from milk. The 10 students who added to this by saying something about the process of manufacturing cheese were spread across the four grade levels. For most of them, it appeared that their knowledge about cheese making was connected to having had personal experiences on farms or relatives who owned farms rather than their age or school grade. Concerning bread, there was no difference in statements that bread is made from dough, but older students were more likely to say that it is made from grain, that the grain must be ground and mixed with other ingredients, that the mixture must be baked, and that a breadmaker or other machine might be used in the process. Of the 21 students credited with giving a good explanation that included both making and then baking dough, one was a kindergartener, four

were first graders, six were second graders, and 10 were third graders. Concerning hamburgers, there was no grade level effect for statements about cooking the meat but older students were more likely to mention killing the animal, cutting it up or taking the meat off it, and shaping the meat into patties.

Achievement Level and Gender Differences

The categories for Questions 18-21 yielded 10 significant relationships with achievement level and 5 with gender. Low achievers were more likely than other students to be unable to respond to Questions 18 and 19, whereas positive relationships with achievement level were seen for identifying crushing or mushing the apples as a step in making applesauce, identifying cooking the apples as a step in making applesauce, adding something acceptable to the idea that cheese is made from milk, stating that bread is made from grain, identifying grinding the wheat as a step in making bread, identifying baking as a step in making bread, and indicating that hamburger meat can come from animals other than cows. Except for the latter response, this pattern indicates that higher achievers had more sophisticated ideas about land-to-hand relationships in producing common foods than lower achievers did. We have no interpretation for the latter relationship, or for the nonlinear relationship seen for mentioning use of a breadmaker or other machine in making bread.

Boys were more likely than girls to be unable to respond when asked how applesauce is made, whereas girls were more likely to say that you need apples and to say that the apples must be cooked. In contrast, girls were more likely than boys to be unable to respond when asked how cheese is made, whereas boys were more likely to say that it is made from milk. We find it interesting that girls seemed to know more about applesauce and boys to know more about

cheese, but we have no interpretation to offer for this finding because we do not see how the difference connects with what is known about gender differences in socialization.

Relationships Among Response Categories

Most of the noteworthy intercorrelations involving categories in this set were correlations between the more sophisticated responses to Questions 18-21 (those that showed the strongest relationships with grade level) and the maturity set of responses to the interview as a whole. In addition, students who were able to add something acceptable to the idea that cheese is made from milk were more likely than other students to be credited with giving a good explanation for how bread is made, students who said that bread is made from dough were more likely than other students to speak of baking the bread, and students who said that bread is made from grain were more likely than other students to speak of grinding the grain. Students who said that hamburger meat comes from cows were more likely than other students to mention meat (not just milk and other dairy products) as reasons why farmers raise cows, as well as to name bacon, ham, or some other specific pork product in explaining why farmers raise pigs.

Rare and Unique Responses

The following responses to Questions 18-21 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 18

Kindergarten: You crush apples and then add sauce; you stir the apples and wait until they turn into applesauce; you cook the sauce, then add diced apples; you smush the apples, then put them into a can that makes applesauce [magic].

First grade: Peel the apples, then cook them in water and add "a jar of applesauce."

Second grade: Squash the apples, then can them and store them until "it gets all mushy;" crush the apples and then add "taste of apple."

Third grade: Crush the apples and then "put some liquids in it;" describes mother making homemade applesauce by peeling and coring the apples, "smishing" them, and then cooking them with sugar; describes grandmother making applesauce by peeling off the skin, taking out the cores, then "smushing" and cooking them; describes peeling, cutting, and smashing apples, then adds that "we made applesauce in our classroom—you put the smashed apples in this machine and turn a handle and it comes out like applesauce" [apparently describing using a crank to operate the machine].

Question 19

Kindergarten: Two kindergarten students included mustard as an ingredient of cheese [apparently thinking of "bar cheese" spreads]; you take "melted cheese" and freeze it so that it turns solid; you take "plain cheese" and wait until it dries; you cook milk.

First grade: You roll it flat, using a thing that you make cookies in [perhaps thinking about making processed cheese treats or some kind of homemade cheese pastry]; cheese is made from fat; cheese is made from some animal; you pour "something" into milk, stir the mix, and then cook it until it gets sticky; "you need milk, and first you have to separate the curds and whey and then you take the whey and you squeeze it into a big ball and that's how you get cheese."

Second grade: Shape milk into a ball of cheese; add yellow food coloring to milk, then freeze; made from eggs; made from wheat; "I think cheese is made from milk, and then this thing

that flattens it down, and there's an orange color thing, and then it clears it up and gives cheese a smell."

"You have milk and you add some things to it and you stir it for a long time and it will get sort of buttery, but if you have those special things in it, then you can make it into cheese and then press it out . . . I think it gets pushed down so that all the extra stuff gets pressed out and you have those big, thick pieces of cheese and then you can cut them like you want. I saw this on Reading Rainbow on television."

Third grade: Shake up milk with butter; made of milk and fat; stir up milk; "sometimes you have to use a factory but in the olden days they had this little machine. You put milk on there and then you would just wait for the milk to get . . . I think they put a little softener into it to make the milk kind of soft, then it would turn into cheese."

Question 20

Kindergarten: Combine dough and butter and put them in the breadmaker (no explanation of dough); made from seeds; gather corn and squish it together; put butter in the stove and cook it (it comes out bread); made from potatoes.

First grade: You frost it and it turns into bread [thinking of cooking frozen dough?]; mix milk, sugar, and "other stuff," then bake; dough is sugar and flour; it's made from pigs and stuff from farms; made from milk; dough is ground up wheat; cook water and "little pieces of bread" together to make bread; made of butter.

"There's a humungous type of seed, because bread is made out of a seed, and so is Cheerios. Cheerios is a type of bread, but only they put it in the refrigerator to get it hardened and then they get it out, put something on it that makes it hard."

Second grade: Made from meat and milk; they get flour from wheat and then they have dough and they knead the dough and they put yeast on it and they put it in the oven and cook it and it's bread [one of only a few responses to mention yeast or rising]; made of vitamins, minerals, and milk; a machine changes wheat into bread [directly]; made of yeast, salt, and eggs [no mention of grain or flour].

Third grade: Made of potatoes; you mix egg and "powder or something;" wheat is turned into flour which makes the yeast and the yeast makes it come up and then you bake it; probably by putting little crumbs and stuff together, like puzzle pieces, then they probably make it a little pushy, so bread would be like soft, and then they put like a little ring on it.

"You get wheat and add a lot of other stuff in, like seasonings. My mom has a breadmaker and puts this sort of brownish-tan like sand stuff in it. I think it's like seasonings. She puts flour in it, wheat, sometimes a little sugar. Then she puts it into the breadmaker, and for awhile it sort of mixes around, and then it's dough and then it usually bakes, and when it's just about done, I get some real fast. It makes the whole house smell good."

"You take the wheat and you grind it and make dough out of it. (What do you add to the wheat to make dough?) Milk and stuff. Most people put like flour in the pan and then they pat out the dough and make it into a big ball and put it in the pan and let it rise for a few minutes, and then they cook it."

"You take some wheat and put butter and eggs into it . . . wait, I think sometimes you have to put in the yeast, and of course you have to put in the flour too. Then you make up a batter, put it into a bread pan thing and bake it for 45 minutes or two hours or something, and that's how you have wheat bread. I'm my grandma's little cooking helper. I know how to make a lot of things."

"First you pick the wheat, then you make it into a flour-type of substance, then you add a whole bunch of ingredients, mix it up, put it in a breadmaker, and you make bread.

Question 21

Kindergarten: Bird, cow, pig.

First grade: The meat comes from McDonald's or Burger King; turkeys; chickens; pigs; "It's made out of chicken and it turns into meat;" pig; cows, pigs, chickens.

Second grade: Deer; pig; cows and bears; deer; pig, cow; cows, pigs, ducks.

Third grade: Pig; pig, cow, chicken; cow, pig, sheep; the butcher cuts the meat into pieces and then "squashes" it to make it into hamburger meat [has the idea of grinding without the term]; cow or pig; pig; pig; cows and pigs; pig or cow; pig, bull, cow; cow, pig; "they take a cow's meat and refrigerate it and then they saw it in strips—you could even do that like farmers do—and then when you want hamburger meat, you just put it in a pan, or if they're having hamburger patties, you pat them out and then cook it." [One of several responses that includes almost everything except grinding the meat].

"You kill the animal and then cut it up and put it in a bowl or something and then drive to McDonald's, and then you bake it there and put it on a hamburger bun." [Omits grinding and seems to believe that one must go to McDonald's to cook hamburgers.]

Discussion

As expected, students' knowledge of land-to-hand progressions involved in bringing common foods to our tables varied considerably, not only with grade level but with the degree to which raw ingredients are transformed and combined with other ingredients in the process of creating the foods and the degree to which steps involved in preparing the foods are done at

home and thus available for observation vs. on farms or in factories and thus outside of most children's experience. The students knew the most about the making of applesauce, which among the foods considered involves the fewest transformations or combinations with other ingredients. More than two-thirds understood that applesauce is basically crushed/mushed apples, although fewer than one-fourth were able to identify any of the specific steps involved in manufacturing it. Specifically, only 21 noted that cooking is involved and only 21 mentioned ingredients other than apples (e.g., sugar, cinnamon). An interesting but surprising finding was that girls knew more than boys about applesauce (and in particular, knew that cooking is involved), but boys knew more than girls about cheese (or at least, were more likely to know that cheese is made from milk).

It is worth noting that primary-grade students in Michigan often visit (with their families) or make field trips (as classes) to apple orchards, especially at harvest time when they can taste freshly made cider. Students who had made such visits may have been more likely than other students to talk about crushing apples as a step in making applesauce (because they had seen crushing being done at an orchard), but less likely to mention cooking the apples (because making cider does not require cooking).

Only about half (50) of the 96 students knew that cheese is made from milk, and of these, only 10 were able to go on to add something else about the manufacturing process. So few students were able to make valid responses that we were able to use only one catch-all category beyond "it's made from milk" (namely that the student added something acceptable to this basic idea). Only two or three students offered anything like an explanation, and several advanced misconceptions (cheese is made by freezing milk or "melted cheese," or that it is made from eggs or wheat). The pattern of responses to Question 19 and to other questions in our interview

confirms previous findings that urban and suburban children tend to know very little about what occurs on farms because they lack direct personal experience with farming. We would add that children in the early grades have very little awareness of food production and manufacturing as an industry. To the extent that they have clear images at all, they tend to think in terms of small family farms on which people raise food in part (or even mostly) for their own consumption but take what they don't need to nearby food stores where it is sold to the public. They seem to have little or no knowledge of massive, corporately owned farms and ranches or of the networks of food manufacturing companies, food transportation systems, storage facilities, and supermarket chains involved in bringing foods to nearby stores.

Creating bread involves somewhat radical transformations and combinations in moving from its raw ingredients to the final product. Perhaps this is why almost a third (30) of the students were unable to respond when asked how bread is made. Most of what the other students said was valid as far as it went, although frequently oversimplified or distorted in some way. Many students thought that bread is made simply by grinding up grain and then cooking it. These students typically made no mention of other ingredients or even of flour or dough. They had learned that bread is made from wheat (or other grains), but knew little or nothing about the process (they probably didn't understand, for example, that flour is milled grain).

The more knowledgeable students made reference to flour or dough and talked about mixing the ingredients and then baking the bread. Many if not most of these students had seen bread made at home (if not from scratch, then at least at the level of baking loaves of frozen dough purchased at the supermarket). Other students might not have seen bread made at home but may have drawn analogies to what they had seen when their parents made cookies, cakes, or other baked goods. In general, the progression of knowledge here seemed to be from knowing

nothing at all to knowing that bread is made from grain but not having any further information about the processes involved, to knowing that flour is milled grain and the flour must be mixed with other ingredients to form dough and then baked to make bread.

Fewer than half (39) of the students understood that the meat in a hamburger comes from cattle. Furthermore, all of these students used the word "cow" rather than "cattle," "steer," or any other term that might suggest that they made a distinction between dairy cows and beef cattle. No student showed any awareness of this distinction.

About 20% of the students mentioned animals other than cows, most typically pigs or chickens. Although incorrect, these statements are understandable given that in recent years the term "burger" has been applied by fast food chains to a range of meat concoctions and even meatless patties that are served on a bun and called "veggie burgers." Surprisingly, despite frequent mention of pigs, only one student mentioned ham and none straightforwardly said that hamburgers are made from ham.

When asked to describe the steps involved in making a hamburger patty, 36 students were unable to respond and the rest limited their responses to killing the animal, removing the meat and cutting it up, and then cooking it. Ten mentioned forming the meat into patties, but only one referred to grinding (calling it "squashing"). Thus, the students were not aware of grinding as a process or the distinction between grinding meat and merely cutting it into small pieces. Furthermore, very few students used the word beef, and none spoke of ground beef. The majority of the responses amounted to little more than "get the meat from the animal, then cook it." Perhaps the students might have shown more awareness of grinding if we had asked them, for example, to distinguish between steak and hamburger meat.

In general, the students displayed not only a lack of specific knowledge but even a lack of awareness of many of the land-to-hand progressions that bring foods to our tables, especially processes that occur on farms or in factories. In particular, most of what they knew about cheese or hamburger meat began with purchase of these products in supermarkets, with little awareness of the processing involved in developing them from their bovine origins. Like their responses to most of the questions in all of our interviews, the students' responses to these land-to-hand progression questions indicated that although they possess practical knowledge about the general nature, appearance, and uses of things in their environment, they often have little knowledge of their essential nature (e.g., flour is milled grain, hamburger meat is ground beef) or the processes involved in manufacturing them.

Products Derived From Farm Animals

Questions 22 through 25 addressed the students' knowledge about the products derived from chickens, cows, pigs, and sheep. So as not to complicate the questions and confuse the students, we referred simply to "farmers" rather than adding "ranchers" and referred simply to "cows" rather than adding "cattle" or "steers." These four questions were arranged in the expected order of difficulty for the students (that is, we expected them to know the most about chicken products but the least about sheep products).

Question 22. Many farmers grow crops but others raise animals. For example, some farmers raise chickens. Why do these farmers raise chickens?

Question 23. Some farmers raise cows. What do we get from cows?

Question 24. Some farmers raise pigs. What do we get from pigs?

Question 25. Some farmers raise sheep. What do we get from sheep?

All but seven of the students were able to give at least one reason why farmers raise chickens. Of these, 62 said for the chicken meat, 50 for the eggs, and 9 to get baby chickens. Only 13 of these students indicated that the chickens were raised to sell to stores, and most of the responses coded in the other categories implied that the meat and eggs derived from the chickens would be used primarily if not solely by the farmer's family. In short, to the extent that the students were working from images here, they were thinking of family farms as subsistence operations, not of large ranches raising animals as profit-making businesses.

All of the students were able to identify something that we get from cows. A heavy majority (87) mentioned milk, more than half (49) mentioned meat, and 12 mentioned other dairy products such as butter, cheese, or ice cream.

In contrast, 26 students were unable to identify products that we get from pigs. Of these, 20 couldn't respond and the other 6 said "mud." These were younger students who had no idea that pigs were good for anything other than "slopping in the mud," and at least some of them seemed to believe that pigs actually make mud. The remaining responses all focused on pigs as food. Of these, 37 referred simply to meat, whereas 21 mentioned ham, 21 bacon, 13 pork/pork chops, and 9 sausages/hot dogs. None of the students mentioned pigskin, leather, etc.

Finally, 26 students also were unable to identify a product that we get from sheep. Of the rest, only 23 mentioned meat (of which none used the specific term mutton and only two referred to lamb or lamb chops), and the rest focused on cloth products. Thirty-nine students referred to clothing, mittens, blankets, or wool fabric, 22 mentioned wool but did not specify any of the cloth products made from it, and 8 mentioned fur, fuzz, fluff, or hair but did not use the term "wool" or talk about the cloth products made from it.

In general, the students knew more about products derived from chickens and cows than about products derived from pigs and sheep. Common responses included meat and eggs from chickens, milk and meat from cows, meat from pigs, and wool/cloth and meat from sheep. There was little or no mention of raising animals as a profit-making business or of tanning the hides of cattle or pigs to create leather products. Finally, only about half as many students were aware of sheep as a source of meat, compared to the awareness levels for chickens, cows, or pigs as sources of meat. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

22. They want to eat them. (What else do we get from chickens?) I can't think . . . eggs.

23. Milk. (Do we get anything else from cows?) [no response]

24. Milk, no, mud. (So, pigs sometimes live in mud, but why would farmers raise pigs?) I don't know.

25. Wool. They cut the wool off. (What else do we get from sheep?) I don't know.

Kate

22. Because they have meat inside of them? (Is there any other reason why they might raise chickens?) Because they want to eat the meat inside of them.

23. Hamburger and stuff. (Do we get anything else from cows?) Steak.

24. I don't know.

25. I don't know.

First Grade

Chris

In general, the students knew more about products derived from chickens and cows than about products derived from pigs and sheep. Common responses included meat and eggs from chickens, milk and meat from cows, meat from pigs, and wool/cloth and meat from sheep. There was little or no mention of raising animals as a profit-making business or of tanning the hides of cattle or pigs to create leather products. Finally, only about half as many students were aware of sheep as a source of meat, compared to the awareness levels for chickens, cows, or pigs as sources of meat. The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

22. They want to eat them. (What else do we get from chickens?) I can't think . . . eggs.

23. Milk. (Do we get anything else from cows?) [no response]

24. Milk, no, mud. (So, pigs sometimes live in mud, but why would farmers raise pigs?) I don't know.

25. Wool. They cut the wool off. (What else do we get from sheep?) I don't know.

Kate

22. Because they have meat inside of them? (Is there any other reason why they might raise chickens?) Because they want to eat the meat inside of them.

23. Hamburger and stuff. (Do we get anything else from cows?) Steak.

24. I don't know.

25. I don't know.

First Grade

Chris

22. Because they like chickens. (Yeah. What do we get from chickens?) Good food. (What's good?) The chicken! (Oh, you mean the chicken meat?) Yes, the chicken meat—meat balls. (Do we get anything else from chickens?) No.

23. Milk. White milk, chocolate milk, every kind. Do we get anything else? No, only milk.

24. Nothing. Just mud. Mud pies.

25. Their hair. (Do you know what we call that hair?) Fur.

Lauren

22. So they can eat eggs. (Is there anything else we get from chickens?) I don't know.

23. Milk. (What else do we get from cows?) Cheese.

24. Meat. (What else do we get from pigs?) I don't know.

25. Clothes. (What sort of clothes?) Wool clothes. (Do we get anything else from sheep?) I don't know.

Second Grade

Mark

22. Meat. (Do we get anything else?) Eggs.

23. Milk. (Anything else?) Meat.

24. Meat. (What do we call the meat?) Bacon.

25. Fur coats. That's all. (Do we get meat from sheep?) Not really.

Emily

22. So they can get eggs for cooked eggs or a lot of different kind of eggs. (What else do we get from chicken?) I don't know.

23. Milk and hamburgers, burgers.

24. We get fat out of pigs. . . . We get ham out of pigs.

25. We get their fur for like blankets so we can keep warm. I don't really know anything else. (Do we get meat from sheep?) No.

Third Grade

Dale

22. So they can have eggs for breakfast and sell eggs. (Is there another reason why they might keep chickens?) I don't know.

23. Milk and meat. (What do we call this meat?) I don't know.

24. Steak and bacon.

25. Clothing, wool. (What do you mean we get clothing?) The spin the wool into yarn and then knit stuff.

Chelsea

22. So they can get money for them so like if they get bigger and they don't want them, they could sell them for money, or they could get the eggs from them and then they could make eggs out of them—the kind that you eat—or you could sell the eggs and get money for them. (Do we get anything else from chickens apart from the eggs?) I don't think so.

23. Milk, meat, and I think that's all.

24. Bacon, more meat. (You said more meat. What do you mean by that?) Sometimes you can get meat from a pig. I'm not sure what it's called but it's meat. I'm not sure what kind of meat, but it's meat and it's stuff that's smushed. I think it's pork or something, and then when you eat it, it's like you're eating a pig or something.

25. Wool, and I think meat. (We do get meat. Do you know what it's called?) No.

Grade Level Differences

The categories for responses to Questions 22-25 yielded 14 significant relationships with grade level. All of these were linear relationships indicating that younger students were more likely to make less sophisticated responses (being unable to respond to Questions 22, 24, and 25, as well as saying that we get mud from pigs), and older students were more likely to make more

sophisticated responses (saying farmers raise chickens for the eggs and to sell them to stores, raise cows for meat and dairy products, raise pigs for bacon, ham, or pork, and raise sheep for meat and woolen cloth and clothing). The more sophisticated responses generally showed progressive increases with each grade level.

Achievement Level and Gender Differences

This set of response categories showed six significant relationships with achievement level and one with gender. Low achievers were more likely to be unable to respond to Questions 22, 24, and 25, and higher achievers were more likely to name bacon or other specific pork products as things that we get from pigs. The remaining relationship with achievement level was a nonlinear one reflecting the fact that 12 high achievers, 7 low achievers, but only 4 average achievers mentioned meat as a product that we get from sheep.

The lone gender difference appeared because six girls but only one boy were unable to say why farmers raise chickens. We hesitate to interpret this finding because of the small numbers of students involved and the fact that there is no trend toward a systematic gender difference either in the remaining categories for responses to Question 22 or in the categories for Questions 23-25.

Relationships Among Response Categories

Students who said that we get meat from cows were more likely than other students to have said that the meat in a hamburger patty comes from a cow when answering Question 21, as well as to name some of the specific steps involved in making a hamburger. They also were more likely than other students to note that we get meat from chicken, to name one or more

specific pork products obtained from pigs, and to say that we get meat from sheep. Thus, these students were more knowledgeable than others about meat and its derivation from animals. Students who specifically mentioned bacon or ham as products that we get from pigs or meat as a product that we get from sheep showed a similar pattern of correlations. In addition, the students who mentioned meat as a product from sheep were more likely than other students to have answered Question 9 by stating that American people eat more beef but Chinese people eat more chicken because of differences in access to these two meats.

Rare and Unique Responses

The following responses to Questions 22-25 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 22

Most responses to Question 22 are well represented by the coding categories, although a few nuances are worth noting. Only nine students talked about raising chickens to get baby chickens, but this number was much larger than the numbers who mentioned baby cows (0), pigs (2), or sheep (1), in responding to subsequent questions.

Two students mentioned that chickens yield feathers that can be used in pillows or beds.

A few students seemed to think that meat from chickens or other animals is used only when they die of natural causes. For example, one third grader stated, "When they die, you could like cut them up and then get the parts that are chicken and cook it. (Is that what happens all the time—farmers just wait for the animals to die?) No, they take care of them and they are like pets." Other students also expressed the idea that farmers take good care of chickens "so

they can have a good life—like they have to put them in a barn, because if they just live out in the wild, they're probably not going to get much food," or "so other people don't shoot them."

Only one student, a third grader, showed detailed knowledge: "One reason they raise chickens is to get their eggs. They sometimes put them in separate coops. One is the fertilized coop with roosters in it and one has just hens. They have both so that way they have one where they will sell the eggs, and the coop with the roosters, the eggs will hatch and they will have more chickens to make more eggs and then more chickens and . . . you know what I mean."

Question 23

There were few mentions of butter, cheese, ice cream, yogurt, or other dairy products other than milk. Similarly, although 49 students spoke of getting meat from cows, only a few mentioned beef, steak, or other more specific terms. Only one student mentioned leather, and this was phrased as a question rather than a confident statement. One other student mentioned "skin" but did not elaborate.

Kindergarten: You can ride on their backs; chocolate milk; chocolate milk.

First grade: Bacon.

Second grade: Skin (unexplained further); you can bottle it and sell it to stores; bacon; all dairy products; bones; yogurt.

Third grade: Heart, insides, beef; butter, dairy stuff; hamburgers, sausage, hot dogs; dairy products; "Do we get leather from cows?" and "If you raise enough cows, you can make your own rodeo if you have a horse."

Question 24

Although a few students had mentioned pork products as meats obtained from cows, many more students mentioned beef products as meats obtained from pigs. This was part of the general pattern of findings indicating less knowledge about pig products than cow products.

Kindergarten: Bologna and steak; beef; we get "nothing" from pigs; pigs' feet; farmers feed pigs to crocodiles; roast beef; turkey or chicken [this is what the student said when asked what we call pig meat; two other students made the same response].

First grade: Milk; pigs do nothing but roll in the mud and make mud; steak; we get nothing from them—just mud; bacon, hamburgers, chicken; ribs; steak.

Second grade: Gum—from under their tongue; beef; you can use their heads for plaques to show that you hunted a pig; fat; beef; movies [Babe, Georgie, Pigs Might Fly].

Third grade: Hamburger; fat; cattle; hamburger; steak; pig tails; sausage, hot dogs, and "some people eat pig plain;" hamburgers, steak; "my mom has earrings that are made from hair from a pig's ear;" "Sometimes you can get meat from a pig. I'm not sure what it's called or what kind of meat, but it's meat and it's stuff that's smushed. I think it's pork or something, and it's like you're eating a pig or something." [Perhaps thinking of Spam or sausages]

Question 25

Kindergarten: None

First grade: They're just an animal [i.e., we don't get useful products from them]; cheese; I think we get food from them but I don't know what kind; explains that we get wool by shaving it off sheep and then adds, "Sheep don't die, but other animals die when they get shed. Sheep don't die because they have these special clippers, so you can clip them off, but other animals are wild and you can't really hold them still, so you've got to kill them."

Second grade: Mentions sheep characters in animal movies [perseverating from earlier response about pigs in movies].

Third grade: Milk; haggis [doesn't use the term but describes it as "stuffing nasty things into a sheep's stomach" and declares the whole idea of it to be gross]; "they spin the wool into yarn and then knit stuff" [an unusually knowledgeable response, given that our clothing interview showed that few students in these grades understand that cloth is sewn or knitted from threads or yarn that are spun from raw material].

Discussion

The students' knowledge about products derived from chickens, cows, pigs, and sheep was uneven: More developed for chickens and cows than for pigs and sheep. Responses concerning cows and pigs focused on edibles, with very little mention of leather. In contrast, responses concerning sheep made more frequent mention of wool or woolen fabrics and clothing than of meat. The responses typically implied images of small family farms with small numbers of animals (perhaps even known individually and treated as pets by family members), not large, corporately owned farms or ranches. Although the students showed some confusion about which meats come from which animals (especially regarding pigs), most of what they said was accurate as far as it went and free of significant misconceptions. However, a few students spoke of certain forms of meat, especially "chicken," as if it were something other than flesh removed from dead animals. That is, despite the common name, some students did not appear to have yet made the connection between the "chicken" that they eat and the chickens found in barnyards. Among students who were aware that our meats are flesh from dead animals, some were under the impression that the flesh is taken from these animals only after they have died natural deaths.

Even the third graders seemed have little awareness of feed lots, slaughter houses, or other "macro" aspects of meat production.

The Costs of Food Processing

Questions 26 and 27 assessed students' awareness of the fact that more highly processed foods tend to cost more than less processed foods and that meals prepared for us in restaurants cost more than the same meals prepared at home.

Question 26. A pound of cereal costs more than a pound of apples. Why is that?

Question 27. It costs more to eat a meal in a restaurant than it does to have the same meal at home. Why is that?

The students had difficulty answering Question 26, partly for the same reasons that children in these age ranges have difficulty responding to Piagetian questions about conservation of mass and volume. Thirty-eight students could not respond and another 43 attempted to deny the premise of the question by suggesting that despite the equivalent weight, you get more cereal because it comes in a bigger box or lasts longer than the apples do. The remaining responses include the idea that cereal costs more because it has additional or more expensive ingredients in it (sugar, marshmallows, honey, food coloring) or around it (toys in the box, the box itself) (15), the fact that cereal needs to be manufactured but apples can be picked and shipped as is (8), and the idea that cereal is better for you than apples (7). Clearly, the majority of the students showed no awareness of the fact that the costs of processing manufactured foods add to the price of the final product.

The students also found Question 27 difficult. Thirty-one could not respond and 22 expressed the incorrect (or at least, confused) idea that we have to pay for food at a restaurant but our food eaten at home is free. The remaining categories include responses that are accurate although varying in degree of direct relevance to the question posed: restaurant food costs more because we have to pay the people who work there for cooking and serving it (34), restaurants offer better food or a greater selection of food than we have at home (12), the restaurant people have already purchased the food and must be reimbursed for that (8), and restaurants are special, fancy places to eat out and we pay for that ambiance (7). The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

26. Cause you have more stuff in it. (We're saying a pound of it, so it weighs exactly the same amount, so why does cereal cost more than apples?) I don't know.

27. I don't know.

Kate

26. I don't know.

27. I don't know.

First Grade

Chris

26. Because cereal has more stuff than the apples do. (OK. Is there any other reasons why it might cost more?) Cereal is bigger because it's a box. Apples are smaller because it's just an apple. (So it's got nothing to do with the box—it's due to the size?) Yeah, cause the box is the big thing, so that's the way.

27. [no response]

Lauren

26. Because of the box. (What about the box?) It might be more. (Can you think of any other reasons why?) Cause there's more cereal in cereal boxes than apples.

27. Cause you gotta pay for the food. (Yeah, but at home you pay for the food because you go to the store and buy it, so why does it still cost more at the restaurant?) I don't know.

Second Grade

Mark

26. Cause it has more stuff to eat instead of just one apple, so you could have five or six apples in a box of cereal. (But they weight the same amount.) Cause they're big and the other ones are little ones and there's lots of them. (Why would that mean that they cost more? They're only little. You'd think they'd cost less.) Cause you can eat it more than one apple. You can eat one apple and it would be gone, but you can eat one bowl of cereal and it wouldn't be gone.

27. Cause they cook the food instead of you.

Emily

26. Because apples don't have a lot of sugar in them. (Can you tell me a little bit more about that?) Well, a lot of sugar will make you go hyper, but apples don't have that much sugar in them.

27. Because people work there and like it costs $2.59 at the store, or when we buy it just costs . . . like if I bought one carrot, it would just be $1.99 probably and it costs more at a store because at home you don't need to pay for it; all you need to do is cook it.

Third Grade

Dale

26. Cause cereal is expensive because it's a nutritious food. (But aren't apples nutritious?) Yeah. . . . I don't know.

27. Cause you don't have to pay at home. (Yeah, but you still went down to the store and when you bought it, you paid for it. But you're right—you didn't pay as much. So why does it cost more at the restaurant?) Because you're ordering a meal at the same time . . . it's more than what you buy at the store. (Why?) I don't know.

Chelsea

26. I think cause apples weigh less than the cereal does because, you know, you could put lots of cereal in one of them boxes up there. You could put like lots of cereal in there and then you could get like a little box and put the apples in there, but I think apples would still weight a lot. (Yeah, I'm saying a pound of apples and a pound of cereal, so they're both the same weight, but the cereal costs more. Why is that?) I don't know. Maybe they like you to pay more for it or maybe it's more nutritious than apples. They could have like bananas in them, but they might have more nutritious in them than apples.

27. Because sometimes restaurants can be expensive, but like McDonald's and Burger King and Hot N' Now—they're not that expensive because they just serve hamburgers and French fries, and sometimes they give out toys, but I think that sometimes Ryan's (a local family steakhouse) can be more better but it costs more because maybe they have too many customers and they like to put up their prices so they don't get so many customers, because sometimes Ryan's is packed. (But would you pay more for eating at Ryan's than you would for eating at home?) Maybe because they're food is like eating at bars and at home, it's just on your plate and you don't have to get up, and your house is for you to live in, but at Ryan's you have to pay to go there and you don't get to live in it.

Grade Level Differences

The younger students were more likely to be unable to respond to these questions and the older students were more likely to give the most sophisticated responses (cereal needs to be manufactured but apples do not; you pay for restaurant workers to cook and serve the food for you, and you have to reimburse them for the money they paid to purchase the food). Older students also were more likely than younger students to say that cereal costs more because it is better for you than apples or to say that a meal costs more in a restaurant because restaurants are special, fancy places to eat out. Even though these two responses were made exclusively by second and third graders, they could not be considered sophisticated answers to the questions posed. We take them as indications that the older students were more able to generate substantive (and reasonable) guesses in the absence of knowledge, whereas the younger students were more likely to be forced to say "I don't know." A final significant relationship with grade

level was nonlinear: First graders were more likely than students in the other three grades to say that we have to pay for food at a restaurant but the food we eat at home is free.

Achievement Level and Gender Differences

The categories for responses to Questions 26 and 27 yielded six significant relationships with achievement level but none with gender. Higher achievers were more likely than other students to provide the most sophisticated response to Question 27 (cereal needs to be manufactured but apples do not). However, higher achievers also were more likely than lower achievers to say that cereal is more expensive because it comes in a bigger box or lasts longer, and there was a nonlinear relationship for the response that cereal is better for you than apples.

Compared to other students, high achievers were less likely to respond to Question 27 by saying that we have to pay for food at a restaurant but the food we eat at home is free, and more likely to say that we have to pay the restaurant staff for cooking and serving the food. In addition, there was a nonlinear relationship for stating that people at the restaurant have already bought the food and need to be reimbursed. In general, the achievement level trend for both of these questions indicated that the higher achievers were more likely than lower achievers to make the most sophisticated responses to the questions (although also more likely to make some of the less sophisticated "good guess" responses).

Relationships Among Response Categories

There were no particularly noteworthy intercorrelations involving categories for responses to Questions 26 and 27, other than the tendency for the more sophisticated responses to correlate with the maturity set of responses to the interview as a whole.

Rare and Unique Responses

The following responses to Questions 26-27 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 26

Kindergarten: None.

First grade: Some cereal has little marshmallows in it, but apples have only juice; "cereal comes in a box and apples come in a bag and the box makes it heavier and the cereal helps a little to make it heavy, and it makes it heavier than the apples." [Quoted as an example of confusion involving mass, volume, and density that led many students to attempt to deny the premise of the question by claiming that the cereal actually weighs more than the apples.]

Second grade: (After the interviewer reasserts that the two weigh the same but the cereal costs more) "It's the last wonder, I guess."

"Because apples are good for you and cereals aren't in any food groups and they are bad for you, so it's going to cost more . . . because it has like sugar and all this expensive stuff so it is really expensive. It only has like no gram of protein, and if it doesn't have any protein, then it must have other bad stuff for you then, and you are going to have to pay for it if you want it." [Includes the key idea that cereal involves extra ingredients and processing that add to its cost, but conflates this with the idea that foods that are bad for you always cost more than foods that are good for you.]

The following second grader is quoted at length as an illustration of good reasoning combined with confusion due to limited knowledge: "Maybe—maybe because of the size of them or how much they have inside . . . maybe the size of the box that they're in . . . You have to make it, and the apples, you grow them and you don't really have to—it takes longer to make cereal, I think, than to grow apples. No, it doesn't cause you can make a box of cereal before a tree grows and you get apples on it. (But you still have to grow whatever goes into the cereal.) Yeah, but if you already have that made, you can put that in and then you can make the cereal, but with the apples you have to wait for a long time, and if you have a ton of apples, but then your apple tree just won't grow any more apples or you have to put in another seed. But with wheat, you have a big field of wheat and there's like another field of wheat and there's a lot of wheat and then you like get all that done, and then you can just go to that other field and ask for wheat and then you take some wheat and you've got your wheat."

Third grade: None.

Question 27

Kindergarten: "Restaurants have cheeseburgers. (Why does it cost more at the restaurant?) Because you need to give money and you spend some of your money. (Why?) Because they tell you, like 29 or 34, and you give them the money and they give money back, and then they give you meals and you take them home and eat them." [One of many responses that referred to picking up fast food rather than eating a meal at a restaurant.]

First grade: You don't have to pay at home because there is no one to pay there, but at a restaurant they have registers that you put your money in [reversed logic].

Second grade: At the restaurant they make the pizza just right; they give you stuff to eat before your dinner; they "make it perfect" at the restaurant.

Third grade: Restaurants are real fancy and cost more . . . people who eat out a lot must have a lot of money.

Another example of reversed logic: In talking about why a regular restaurant is more expensive than a fast food place, a third grader says that, "Maybe they have too many customers and they like to put up their prices so they don't get too many customers, because sometimes the place is packed."

An unusually complete response: "Because you're going out and they need money and they pay you back and you need food, and if you get food you need to pay them some. (But you pay them more than if you ate it at home.) Because you sit down and you hear music and it's really fancy. (Are you paying for anything else?) Your food and the drinks and the table and the seats and you let people make stuff for you."

Another unusually complete response: "Because when you eat at home, you're just cooking your own food at home, and in a restaurant, you have to pay to drive there for the gas, and then you have to pay for your table and then usually people set out a tip for the waitress, and also somebody else has to cook it for you, and restaurants are usually much fancier."

Discussion

The students' answers to Questions 26 and 27 revealed little awareness of the fact that food prices must cover the costs of labor involving manufacturing, packaging, shipping, and other processing of the food, and in the case of food eaten at restaurants, the services of the restaurant staff. Nor was there much awareness of food production, manufacturing, distribution, or service as major industries driven by large corporations operating nationally and internationally. To the extent that the students' responses to these and related questions on the

interview were based on images of the processes involved, these images featured small family farms supplying food to local stores and restaurants, where any needed processing was accomplished on site.

Students' difficulties in answering Question 26 were compounded by confusions surrounding mass, volume, density, and related concepts. Some students visualized a box of cereal compared to just one apple rather than a bag of apples, and even those who did visualize a bag of apples often had difficulty retaining the idea that the cereal and the apples weighed the same because the larger size of the cereal box made it seem that there must be more cereal than apples. At least eight students never were able to grasp the idea that the two items weighed the same despite differences in apparent (or actual) size. Another factor complicating responses to Question 26 was that some students determined that the costs involved in manufacturing the cereal box would exceed the costs involved in manufacturing whatever container (if any) held the apples, and some raised the possibility that the box might contain a toy or trinket in addition to the cereal. Only eight students directly stated the idea that cereal is more expensive because it has to be manufactured, although this idea also was implicit in some of the 15 responses that included the idea that cereal has additional or more expensive ingredients in it (sugar, marshmallows, honey, food coloring) or around it (toys in the box, the box itself).

The students showed more awareness of the labor costs involved in food preparation in their responses to Question 27, where more than a third (34) of them indicated that we have to pay the restaurant staff for cooking and serving the food. This is not surprising, given that the students had much more direct experience with restaurants than with the processes (and payrolls) involved in food manufacturing and distribution. Other students, lacking this basic insight, struggled to construct explanations for why eating the same meal is more expensive in a

restaurant. Some of them pointed to the "specialness" of the ambiance of eating out, whereas others suggested that the food is of better quality than what you have at home, that there is more of it or extras that come with it, or that they prepare it more elegantly or "perfectly" than you could at home.

Steps in Growing Corn

Question 28 addressed the students' knowledge of some of the processes involved in raising crops. Specifically, it asked about steps involved in raising corn, a crop that we expected the students to know relatively more about, not only because it is commonly grown locally but because corn plants are salient because of their size and because the corn served at our tables is only minimally transformed from its appearance when harvested from the fields.

Question 28. Many farmers grow corn. Tell me about the steps that farmers go through to grow corn.

Only seven students were unable to respond to this question, confirming our expectation that most students would know at least something about corn cultivation. The most common steps identified were planting the seeds (85), watering the plants (63), waiting for the plants to grow until they are ready to be harvested (72), and picking, cutting, or harvesting the corn (65). Steps mentioned by minorities of the students included weeding, raking, hoeing, or otherwise preparing the soil for planting (11), making sure that the corn gets enough sunshine (12), fertilizing the corn or spraying pesticides (7), shucking or cleaning the corn after it is harvested (18), and clearing the field or plowing for the next planting (9). Most responses were valid as far as they went and free of misconceptions.

The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

Buys the seeds. (OK, he starts with the seeds. Then what does he do?) He plants it. (Um hm, good. Then what does he do once he's planted the seeds?) It grows out. (Good. Then what does he do? Does he have to do anything to it while it's growing?) Water it. (OK, so he's watered it, it's growing. What does he do then?) It needs sun.

Kate

Seeds. (What about the seeds?) You can have corn seeds. (Then what would you do?) Grow them . . . you stick them in the dirt and you grow them. (Do you have to do anything to them once you stuck them in the dirt?) Water them, and then you have to make sure you have sunshine on them.

First Grade

Chris

Usually they get corn seeds and grow them. (OK. What do they do with the seeds?) They put them in the dirt. (Then what do they do?) They put dirt on the seed, they water it, then it will grow for a long time, for all day, and then it will be corn, and then you pick the corn, then you eat it. (Between picking the corn and planting the new corn, do they need to do anything?) Yeah, put the seed back in there, put the dirt on there, and water it, and then there'll be more corn.

Lauren

I don't know. (What does the farmer do first?) Puts the seed in the ground. (Then what does he do?) He waters the corn. (Then what does he do?) Picks the corn. (Then what does he do?) Eats it. (Does he have to do anything in between picking then corn and then planting new corn?) I don't know.

Second Grade

Mark

You plant it, you bury it, and you water it. (Then what do you do?) Then it grows and then you pick off the corn and then you eat it. (Do you have to do anything between

harvesting it one year and planting the new crop?) You have to tear them down after all the corn's picked off and then grow more.

Emily

So they can have some corn. (How do they grow it?) They grow it by seeds. (They plant the seeds. Then what do they do?) They get it in deep, deep soil—good soil—then they cover the seed up and water it and then it will grow up. (Then what do they do?) They pick and then they cook it. (After the corn is picked and taken away, what does the farmer do before planting the next year's crop?) He makes sure that his soil is ready for it.

Third Grade

Dale

They go to the store and buy seeds and then they plant the seeds and water the seeds. Then when it's time, they pick the corn.

Chelsea

First you have to plant it, you have to water it, let it get sunshine, you have to put it where it gets lots and lots of sunshine so you can grow big crops of corn, and like if you get not that big a corn, maybe you didn't give it enough water or you didn't give it enough sunlight. (So you've planted it and watered it. What comes next?) Water and sunshine go together and then it starts to grow. (Then what do you do?) When it gets bigger, you pick it off the stalk and you peel it and eat it. (Do you have to do anything between picking it and planting next year's crop?) I'm not sure.

Grade Level Differences

Six of the seven students unable to respond to the question were kindergarteners or first graders. Of the remaining response categories, five showed significant positive relationships with grade level: Older students were more likely than younger students to mention planting the seeds, waiting for the plants to mature, fertilizing or spraying pesticides, harvesting the corn, and clearing the field or plowing to prepare for the next planting.

Achievement Level and Gender Differences

Second grade: After the corn flowers sprout, bees pollinate them; the picked corn is sent through a pipe from a truck.

"Digs everything out and plants it—the seed. Then water it, fertilize it, pick the weeds, and it will start growing. Then he picks the top off and he cuts it, and with a tractor he comes and picks it up and puts it in a trailer. He takes it back and breaks them off the stick and then the store will do it and put them out so you can get it."

Third grade: You plant it where there's sun and not a lot of trees—usually in corn fields—and as it grows, you keep crows and other animals away from it.

The following is one of several students influenced by the "knee high by the Fourth of July" saying, although she didn't remember it exactly: "On July Fourth they go and if the corn is bigger than their knee or ankle, I can't remember which, it'll have good corn. But if it's lower than their ankle or their knee or whatever they're measuring it by, then it won't make it through."

The following are quoted as three of the more complete answers.

"They plant the seeds by spreading them with a combine. Then you first need to water them—the rain waters them, and just give them sunshine, and they grow. They get big and then the corn comes out. (And then what happens?) Some people peel them off. Well, actually the combine comes and it's got something like blades that go around and around and they rip them off and then they go into this thing that keeps them there. I think it waters them, and they clean it." [Explains that his grandfather was a farmer and he watched some of this.]

"First they have to get the garden ready to plant their corn. Then they put in the seeds, water them, and by the time they have their first sprout, they have to make sure the garden still has the right soil for it—make sure that they don't have hard soil. I know this because my next-door neighbor has a huge garden—corn, squash, everything. Once they have their sprouts up,

they keep checking and sometimes they put bug spray and things on them to keep the animals away from them. When they're getting up to the part where they come up to my knee, sometimes they put fences around them, cause that's the real time where the other animals can see them, and by the time they're as big as me, it's time to harvest the corn. Usually only half of the garden makes it."

"They first plow the ground flat, make little hills to plant the seeds in, plant the seeds, plow it flat, and if you were an Indian, you'd put dead fish in it. That just makes the soil better. Then you plow, let the corn grow, weed it and tend it and care for it, and pretty soon it comes harvesting season and you go out with your big tractor and just go over the corn and somehow it picks out the corn. (What does the farmer do before planting the following year's crop?) He takes out the roots and the stalks that are left."

Discussion

Students' responses to Question 28 were among their most impressive for the interview as a whole, both for accurate specification of details and for the absence of misconceptions. However, it should be noted that most responses were not nearly as accurate and detailed as the few quoted above. Instead, they were confined to stating the popularly mentioned response categories: plant the seeds, water the plants, wait for them to mature, and then harvest them. The most detailed knowledge appeared to have been acquired outside of school by students whose neighbors or relatives grew corn in gardens or on farms. However, some students communicated knowledge obviously picked up at school, especially the idea that Indians used fish as fertilizer (a detail commonly included in stories about how local Native Americans helped

the Pilgrims learn to raise crops, included in teaching about Thanksgiving or units on America in the 17th century).

Responses to most of our interviews have shown that the students have relatively little awareness of the role of geography and climate in affecting people's lives. In this case they did show knowledge that crops require optimal amounts of both sunshine and rain (or irrigation), as well as knowledge that corn plants are grown from seeds. However, only small minorities indicated knowledge of the need to prepare the soil prior to planting, to protect the plants from pests, or to clear the field as part of the preparation for the next planting.

Climates Suitable for Farming

Question 29 more directly addressed the students' knowledge that possibilities for farming are affected by climate and geography.

Question 29. There are lots of farmers around here but there are not so many farmers in Alaska. Why not?

About 40% (39) of the students were unable to respond to this question, and many of the others could only say that it is too cold/snowy in Alaska (18) or that not as many people live in Alaska as in Michigan (10). The remaining students specified that it is too cold/snowy to grow crops in Alaska (26), that it is too cold for animals to survive there (7), or that there is not enough sunlight there (7). The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

I don't know.

Kate

Cause a lot of people don't live in Alaska. (Why don't a lot of people live in Alaska?) Cause it's so cold.

First Grade

Chris

Cause Alaska has more farmers [couldn't explain].

Lauren

I don't know.

Second Grade

Mark

Cause it's not a good place to harvest food. (Why?) Cause they don't have good soil and dirt.

Emily

Because they probably didn't want any up there.

Third Grade

Dale

Because in Alaska it's too cold, and too hot in the summer.

Chelsea

Because Alaska's got a whole bunch of snow and sometimes it only snows once a year here, and it snows continuously in Alaska.

Grade Level Differences

The response categories for Question 29 showed unusually strong relationships with grade level. Younger students were much more likely to be unable to respond to the question,

whereas older students were much more likely to say that Alaska is too cold/snowy (without being able to explain further), to say that it is too cold/snowy to grow crops or allow animals to survive there, or to say that there is not enough sunlight there.

Achievement Level and Gender Differences

There were three significant relationships with achievement level but none for gender. Lower achievers were more likely than other students to be unable to respond to the question, whereas average and higher achievers were more likely to say that it is too cold/snowy to grow crops in Alaska or that there is not enough sunlight there. The grade level and achievement level data indicate that the older and higher achieving students had more knowledge relevant to this question than the younger and lower achieving students.

Relationships Among Response Categories

None of these response categories showed noteworthy intercorrelations except for the expected relationships between sophisticated responses and the maturity set for the interview as a whole.

Rare and Unique Responses

Many of the younger students, especially in kindergarten, did not know where Alaska is and thus did not get the point of the question. Other students made comments about Alaska that varied in validity but did not address the question of why there is less farming there.

Kindergarten: None.

First grade: Because Michigan is a bigger state; because there is not much room there [these two first graders and a few other students inferred from the question that Alaska must be small because there isn't much farming there]; if you were planting up there, you'd get frostbitten [one of several responses that focused on the effects of Alaskan climate on people rather than on crops].

Second grade: Alaska lacks good soil and dirt; Alaska lacks "our kind of" dirt; there is not much dirt up there—just snow and ice; polar bears would eat all the crops; gives a detailed explanation of how we have four seasons here because we are in between the ends of the earth and the equator [a rare detailed and accurate geographic response].

Third grade: They don't have corn or "the right animals" up there, so they can't grow it and sell it—also, it's drier down here; there is no grass or dirt there—just ice; they have volcanoes there; Alaska is an island and there aren't many fields there; we have better soil here.

Finally, two third graders talked about cycles of day and night (one saying that we have 60 and the other 66 straight days of day, then 60 or 66 straight days of night). Their knowledge on this point was too vague and incorrect to allow them to bring it to bear on the question (i.e., neither said that farmers can grow crops in Alaska only during the summer when there is lots of daylight).

Discussion

Once again we see limitations in the students' knowledge about how geography and climate constrain human activities. Only about half of the students were able to provide substantive responses that spoke to the question, and most of these were limited to the general idea that it is too cold/snowy in Alaska to allow plants to grow well. However, a few students did mention other factors such as the availability of sunshine and the quality of the soil.

Modernization of Farming

The last three questions addressed students' knowledge about the ways in which machines and other inventions have revolutionized farming, in terms of both changing the methods used and multiplying the yields per acre.

Question 30. How is farming today different from farming 100 years ago?

Question 31. What are some inventions that have helped farmers?

Question 32. Long ago, most people had to be farmers in order to produce enough food to feed everyone. But today, only a few farmers produce all the food we need. Why is that?

Almost half (45) of the students could not say how farming is different today from 100 years ago. Among students who were able to respond, the most popular answer was that today's farmers use tractors and other large machines (29). Other responses included the ideas that today's farmers have better tools (8), unelaborated statements that farming is easier now than in the past (7), and statements that today's farmers enjoy a wider range or better quality of animals, plants, or seeds (7).

When asked about inventions that have helped farmers, 29 students could not respond and another 7 mentioned horses, cows, or other animals. Among those who were able to name inventions, 37 named tractors, 27 named tillers, combines, or other large farm machines other

than tractors, 17 mentioned pitchforks, rakes, shovels, hoes, or other hand tools, and 15 mentioned machines or motors without becoming more specific. In general, responses to Questions 30 and 31 indicated that although a few students were quite well informed, the vast majority had very little knowledge about how farming has evolved over the last couple of centuries and the role of key inventions in producing these changes.

The last question asked how it could be that most people had to be farmers in the past but today a relative handful of farmers (per capita) can produce all the food we need. Almost two-thirds (60) of the students could not respond to this question. Of the rest, seven said that farmers have more knowledge now, 17 that farms are bigger now, and 22 that farmers have better equipment now. Of these students, none specifically mentioned increases in yield per acre and only 14 specifically stated that machines increase farm workers' productivity (i.e., allow them to get more done in a day than they could previously). The following examples from average-achieving boys and girls are representative of the responses from students across the four grade levels.

Kindergarten

Jered

30. I don't know.

31. I don't know.

32. Cause they have a garden and they have lots of stuff there. [couldn't explain]

Kate

30. A hundred years ago, there weren't very much people who hunted. (Why was that?) Because there weren't very much farmers who hunted.

31. I don't know.
32. Cause you can buy it from people who have the store. You could hunt for the store and then you can bring it to the store and then they can put it in a plastic jar or something

or in a glass jar. (So the hunters can take their food to the store. What about the farmers? Why can they feed everybody?) Cause they hunt.

First Grade

Chris

30. I don't know.

31. Cows, pigs. (Do you know what inventions are?) Stuff around the farms, like the pig. (Do today's farmers have farming tools that were not available or methods that were not available?) There's no farmer's tools. All there is is a bucket for the cows. That's all the farmer's tools.

32. I don't know.

Lauren

30. Cause there's all these big machines that help the farmers.

31. I don't know.

32. I don't know.

Second Grade

Mark

30. They didn't have farming 100 years ago . . . they'd hunt animals.

31. Tractors.

32. Because they have more places to buy it. (What do you mean?) They buy seeds and then plant them, and then they grow and then they pick them off and eat them. (But once upon a time, almost every family had to have a farm so the family could have enough food, but now there's lots and lots more people and not as many farmers. So why is that?) Cause people have more money and they can buy houses instead of farms, and they can buy food, but some people can't. (Right, but where does the food come from?) From other countries. They get it on a boat and then they sail it over to here and give it to the company and then they give it to the store.

Emily

30. It was hard back then and now it's easier because we've got some tools and they use their hands and stuff. Like people had to use this smacker thing to get the black people to work because back then the black people were poor and stuff, but the white people didn't really care about the black people. Back then the black people had to work for the white people and the white people treated the black people like the horses, cause they were hitting them and trying to get the black people to work on the crops, but some of them had to die because they weren't working on them.

31. Knowing how to grow the crops . . . big machines.

32. I don't really know.

Third Grade

Dale

30. Today we have bigger land and they had smaller land. (What do you mean by that?) People share land so the farmers could plant their crops for the people that are sharing their land.

31. Tractors.

32. Because back then you didn't have stores where you could go buy food and today we have stores. We can go buy seeds and we can plant a lot of seeds . . . the farmers have bigger farms than back then.

Chelsea

30. Well, I think sometimes they didn't have the food that we have now, and maybe sometimes them kind of farmers did not have a lot of money to buy the seeds that we have now, and maybe they didn't have enough money to, but maybe for selling their crops or something, they could trade in the crops and get money and then they could go buy more seeds for it.

31. The plow and the tractor.

32. Because maybe long ago, farmers didn't have enough crops or enough stuff to feed everybody, but maybe now they have like a huge area of land and you could have more room to put like a garden or you could have more room to put crops and corn and tomatoes and cucumbers and squash. (Why do they have more room now?) Because maybe some people don't need that much room to live on or that much land. They probably don't need that much land to live on, but probably long ago they did because maybe they had more stuff than we have now. (But why is it those few farmers are still able to produce all that food?) Because maybe some houses got knocked down or got struck by lightning, and sometimes when they get struck by lightning or a tree gets struck by lightning sometimes it falls on houses or something and then it could wreck your

house, and maybe the farmer just moved right on to the land that was probably next door right to them and instead of wasting the land, they probably just used the land for crops and everything.

Grade Level Differences

For all three questions, younger students were more likely to be unable to respond and older students more likely to make sophisticated responses. In particular, the older students were more likely to say that farming is different today from 100 years ago because today's farmers have better tools and use machines, to name tractors and other farm machines as specific examples of inventions that have helped farmers, and to say that today's farmers produce more food because their farms are bigger, they have better equipment, and they have machines that allow them to get more done in the same time. The last two statements were made exclusively by second- and third graders.

Achievement Level and Gender Differences

Categories for responses to Questions 30-32 showed two significant relationships with achievement level and four with gender. The achievement level relationships indicated that higher achievers were more likely than other students to name specific farm machines other than tractors as examples of inventions that have helped farmers and to suggest that today's farmers are more productive because their farms are bigger than the farms of the past.

The gender differences all appear to favor boys. More girls than boys were unable to respond to Question 32, and there were nonsignificant trends in the same direction for inability to respond to Questions 30 and 31. In contrast, all seven of the students who answered Question 30 by saying that farmers in the past lacked the range or quality of animals, plants, or seeds that today's farmers enjoy were boys. Furthermore, 23 of the 37 students who named tractors as

inventions that have helped farmers were boys, as were 6 of the 7 students who said that today's farmers can produce more food per capita because they have more knowledge than farmers of the past. The gender differences in responses to this set of questions may have appeared because farm work (especially work done using machines or large tools) is often depicted as gendered work in children's literature. In farm family scenes, for example, men are more likely to be shown working with tractors or combines, whereas women are more likely to be shown gathering eggs or working in the kitchen.

Relationships Among Response Categories

Students who mentioned hand tools in responding to Question 30 were more likely than other students to mention hand tools in responding to Question 31. Similarly, students who mentioned machines in responding to Question 30 were more likely to mention machines in responding to Questions 31 and 32, as well as to identify tractors or other specific farm machines as inventions that have helped farmers. Otherwise, the only noteworthy intercorrelations involving categories for responses to Questions 30-32 involved the tendency for the more sophisticated responses to correlate with the maturity set of responses to the interview as a whole.

Rare and Unique Responses

The following responses to Questions 30-32 involve interesting elaborations on the ideas represented by the coding categories or embody ideas that are not included in those categories.

Question 30

Kindergarten: None.

First grade: Farmers back then were Indians; farming is easier now due to better foods and grinders and stuff; easier now due to motors; easier now due to shovels, pails, barns, fences, and better knowledge about farming; today's farmhouses are different; they planted different things; we have scientists now.

Second grade: They didn't have tractors or modern tools, so they had to use a lot of people to do the work that one could do today [This was one of just four students who verbalized this principle spontaneously before it was asked about in Question 32]; today we have inventions and new knowledge; machines do the work faster; the ground was harder then because it was less worked; we have better tools today and back then they had to use slaves to get the work done; today we have sprinklers to use if there is no rain, and better tools like rakes; back then there were more farmers, so each had to farm a smaller space, so they all could have equal space; they had smaller fields then because they didn't have big machines to go as far; today we know how to make it better, "because those people were kind of older—old people who would mess up and have to do it again until they got it right" [presentism: We are smarter today than "old" people from the past].

Third grade: You can grow more now with machines; they didn't have as much money to buy seeds; they had more rain then; they didn't have big modern barns.

One third grader offered an interesting economic explanation: "Because land back then cost a lot of money. It'd about $50 per acre, and that's about a bizillion dollars now . . . Because–I don't know what it was like back then, but now, I mean, $100 for an acre of land—that's cheap. It's cheaper than my portable TV. So you could buy thousands of acres of land and they can harvest it all in one shot. . . You could with all those inventions. So then they can

have lots of acres of land because they have the money to do that, and the more acres of land, the more you can plant, and the more you can harvest."

Question 31

Kindergarten: None.

First grade: Soil-making machines; weed whackers; computers.

Second grade: Airplanes; jackhammers; hay baler; electricity; cars and trucks; knowledge of how to grow crops better; steam to power big machines.

Third grade: Eurosealer; wheels, windmills, fences to keep animals in; electric lights; electric lights.

Question 32

Kindergarten: None.

First grade: We have animals to help—cows give milk and meat, pigs give ham [this and a few other students seemed to think that farmers in the past didn't have animals, or in a more sophisticated version, that they had only a few animals on family farms but modern farms have hundreds]; people today have more money so if they want to farm they can buy more land and have bigger farms.

Second grade: We have modern tools and machines, they had to do everything by hand so it took a lot more people to do the work that one person can do today; we have animals and they didn't; we can plant more with tractors; machines do the work faster; today we have stores that the farmers can sell to, so the farmers plant more [profit motive]; equipment today makes harvesting a lot faster—when they had to do it by hand, a lot of crops died before the farmers could harvest them; today there are stores to sell to so the farmers plant more; machines "make it easier" now so we have bigger farms; we grow more now because machines make it easier to

farm; they had smaller fields in the past because they didn't have big machines to allow them to go as far as they can go today.

Third grade: More machines and better fertilizers; more machines that get the work done quicker; more machines so they can work faster; we have more stuff today [no further explanation]; rabbits and gophers help by eating chaff [so farmers have less to clear]; you can grow more now with machines; now farmers can buy seeds—lots more seeds than they had when they would only use what they got from their own farming; farmers get more land now because other people need less of the land to live on; tractors and other machines; stores today buy food from farmers so they grow more, and also we import food from other countries; you can plant faster with machines; we get food from other countries today; farmers can buy more seeds now; machines make the work go faster; machines allow the farmer to harvest more land more quickly.

One third grader had particularly noteworthy knowledge about the modernization of farming. Her answer to Question 28 was "One hundred years ago when they had to plant their corn, they would have to walk up and down and make rows with those old fashioned plows. They would have to make rows with those and as they were making the rows, they would drop the seeds behind them. That's what Pa did on Laura Ingalls Wilder. Today, all they have to do is have machines with a sharp blade at the end and they just drive up and down the field." Later, when asked about inventions that have helped farmers, she said: "There's the manure spreader and the thing that makes the rows, and those really long sprinklers, and like a wheat picker or something and a corn picker and I think there's a seed spreader." Finally, when asked why a few farmers can produce all the food that we need today, she said: "Because they have a lot more

room than people did in the past and they have inventions where they can go a lot faster up and down and it only takes them a little bit of time and they make their rows really close together so they can have a lot."

Discussion

Grade level differences were especially prominent in the responses to these last three questions. The kindergarteners and first graders had little or no knowledge about the revolution in farming (except for one first grader who lived next to a farm). In contrast, about half of the second and third graders generated responses that were valid as far as they went, and a few displayed considerable knowledge about modern farming. In general, the students were much more aware of tractors and other large machines as inventions that have helped farmers; only a few mentioned seeds, fertilizers, or sprays, and none mentioned crop rotation or other specific techniques. Finally, only 14 specifically stated that machines multiply what a single worker can accomplish in a day and none said anything to indicate awareness of the fact that modern farms are more productive not only because they are bigger but because they produce a greater yield per acre than farms in the past.

Misconceptions were infrequent, although some did appear. Several students thought that we have more animals now than they did in the past, one student thought that there was more rain in the past, and one thought that all farmers at one time were Indians. More common than clearly incorrect misconceptions were nuances of elaboration on valid ideas that included some invalid elements: The ground was harder in the past because it was less worked, most farm work in the past was done by slaves, the system was arranged so that each farmer had the same sized farm, farmers had to produce their own seeds because they lacked the money to buy seeds

at a store, today's big farm machines are steam powered, farmers welcome rabbits and gophers because they eat chaff, farmers can get more land now because it has been freed up by people leaving farming to move to cities, and we need fewer farmers today because we import food from other countries. Many of these ideas are aspects or implications of the larger trend noted earlier: To the extent that the students' responses to this interview were guided by particular images of farming, those images were centered on small family farms like those depicted in children's literature (e.g., *Little House on the Prairie*), not large corporate operations.

General Discussion

The students' responses to the food interview displayed many of the same patterns seen earlier in their responses to the shelter and clothing interviews: They knew more about the physical appearances of things than their underlying natures, and more about the uses of finished products than about the land-to-hand transformations involved in creating those products. Sophistication of responses was related much more closely to age (grade level) and personal experiences out of school than to achievement level or gender. Knowledge about the past was limited and tinged with presentism, knowledge about other cultures was limited and tinged with chauvinism, and there was only limited evidence of historical or cultural empathy (i.e., understanding people's behavior as sensible adaptation to their time and place).

Responses to the initial questions indicated that the students understood that we need food to maintain our health and vitality and that certain foods are better for us than others. However, they had difficulty defining food and distinguishing food from nonfood because they lacked biological knowledge of how our bodies process food and the functions that food fulfills in providing us with nutrients and energy. The students commonly said that we need food to stay

alive and that food helps us to grow and be healthy, but only 14 of them mentioned that food provides energy, and only a few cited this fact in distinguishing food from nonfood. The majority sought to distinguish food from nonfood by citing social convention (things that we eat are food and other things are not) or listing examples of food and nonfood items. Others tried to draw distinctions based on common characteristics of foods. These tended to be too specific and sometimes embodied misconceptions (things that we eat that are good for us are food, but other things that we might eat are poison; food is healthy or good for you; food consists of soft or chewy substances but not harder things or liquids; food has taste or a good taste but nonfoods have no taste or a bad taste).

In general, almost all of the students understood that we need food to sustain life and remain healthy, and majorities were able to define or describe food and distinguish it from nonfood. However, many of these responses were based on appearances or external characteristics (food has taste, contains juice or seeds, etc.) or involved circular reasoning (we eat things because they are food and food is food because we eat it) or reversed logic (foods are things that we eat with a fork or spoon). Even the minority of students who talked about food as healthful or used terms such as "energy" or "vitamins" did not know much about the nature of food or how it exerts its effects on our bodies.

Only three of the kindergarten students were able to identify conventional food groups, but majorities of the students in first, second, and third grade could do so. These students often used alternative terms (e.g., sugars for carbohydrates, bread or wheat for grains), but the groups that they identified corresponded well with the groups conventionally identified in the food pyramids used for nutrition education. Combined with their responses to subsequent questions about healthful vs. junk foods, the students' responses concerning food groups suggested that

they were a little more knowledgeable about the relationships between food and health than previous research had suggested. This probably reflects the increased emphasis on nutrition education that has occurred in recent years, and in particular, the emphasis on care of one's teeth and the use of food pyramids to organize discussions of food groups and recommended diets.

The students had difficulty with Questions 4 and 5, which asked for comparisons between foods eaten today and foods eaten in 1920. Only 19 were able to identify foods available today that were not available in 1920, and only 16 were able to identify foods commonly eaten in 1920 that are no longer commonly eaten today. Many students were confused about the time period in question and made reference to the pioneers, the Native Americans, or even prehistoric times. Few of them showed much awareness of the relatively recent vintage of modern food processing and packaging methods or the fact that certain foods have become commonplace only in recent decades (especially frozen foods and other convenience foods prepared and packaged to minimize preparation time).

Some students essentially begged the question and engaged in a form of reversed logic by stating that certain foods were unavailable in the past because there were no supermarkets then. This kind of explanation appeared occasionally in our previous interviews on shelter and clothing and appears again in some of the responses to subsequent questions in the food interview. It appears because certain students connect the introduction of certain cultural artifacts with the appearance of stores that sell them, whether these be food items, clothing items, tools, or anything else that today is commonly bought at a store. Thus, we are told that people in the past did not have cereal or soup because there weren't groceries where you could buy food, that they had only a few varieties of seeds available because there were no seed stores, and so on. For some students, "because there were no stores" is an all-purpose answer to "Why didn't

people in the past have _____?" questions, just as "God" or "the President" are all purpose answers to "Who decided _____" questions and "Because of their culture" or "Because of their religion" are all purpose answers to questions about behavior that contrasts with what is commonly seen in the contemporary United States.

Very few students gave answers to Questions 4 and 5 that were accurate both in their identification of foods that are eaten now but were not in the 1920s (or vice versa) and in their explanations for the contrast. Sometimes the students were accurate in their identification of differential food consumption patterns but incorrect in their explanations. For example, one student said that people didn't eat hamburgers in the past because they didn't have grills (rather than citing the more fundamental reason that they hadn't learned to grind meat), and another said that we eat less deer today than in the past because there are fewer deer around (rather than because people prefer beef to deer meat and the food production industry has responded accordingly). Other students made correct statements about inventions that have been incorporated into today's food production technology, but drew incorrect inferences about the availability of certain foods in the past. For example, one student assumed that beer, soft drinks, and popcorn did not exist prior to the discovery of electricity and another thought that modern machinery is required to manufacture both cheese and noodles, and thus inferred that people didn't eat macaroni and cheese until recent decades. Another student thought that we eat more junk foods today than in the past because modern medicine allows us to do so (i.e., the damage caused by the junk foods can be minimized or reversed). In general, the students' responses reflected the fact that contemporary American eating practices (featuring processed and packaged foods, frozen foods, ethnic and other specialty foods, and frequent meals at family

restaurants or consumption of food taken home from fast food outlets) were all that most of them had ever known.

Besides having difficulty comparing foods eaten in the present vs. the past in the United States, the students had difficulty comparing foods eaten in the United States vs. elsewhere in the world. Only 12 identified a food that is eaten commonly in the United States but not in many other places, and only 27 could identify specific foods eaten more routinely elsewhere than here. In addition, some of the students displayed chauvinism in their responses to Questions 6 and 7, such as in the reference to chopsticks as "weird tools" used to eat Chinese food.

Along with traditional American "meat and potatoes" meals, students frequently mentioned spaghetti and meatballs, macaroni and cheese, pizza, or tacos as typical American fare. This reflects the fact that certain foods originally considered ethnic are now so commonplace in the United States that it makes sense to classify them as American foods. Many students had difficulty drawing comparisons between the United States and Japan, partly because there is no common stereotype of Japanese food and partly because they were under the impression that certain foods commonly eaten here are not also commonly eaten in Japan (fruits and vegetables, candy, processed and packaged foods). The students generally found it easier to talk about foods eaten commonly in other countries but not in the United States than to talk about foods eaten commonly in the United States but not in other countries. This is understandable given that the students were American children with little or no direct experience with life in other countries.

When asked about foods brought to America from other countries, most students referred to ethnic foods introduced during the 20th century. A few went as far back as the Pilgrims or other early English settlers, but none referred to Columbus or the Encounter. Only a minority of

the students was able to name general crops or specific dishes brought here from elsewhere, primarily Italy, Mexico, or Asia. Most of the children possessed stereotypes (largely accurate as far as they went) of Italian, Mexican, and Chinese food.

The students struggled with questions about why Americans eat more beef and bread but Chinese people eat more chicken and rice. Only about a third of the students were able to make substantive responses to these questions, and most of these were unexplained references to differential access (e.g., Americans raise more wheat but Chinese people raise more rice). Typically, only a few students showed clear awareness of geography's influence on decisions about what crops to raise, and even fewer displayed awareness of its influence on decisions about raising animals. Lacking awareness of the role of geography in influencing regional crop- and animal raising patterns (let alone specific knowledge of the causal mechanisms involved), the students tended to attribute the contrasts between American and Chinese diets to taste differences or unexplained differences in access to the foods involved.

The students' responses to questions about cooking, refrigerating, and preserving foods revealed very little knowledge about bacteria or other organisms present in foods that might pose health risks. Consequently, few of them depicted cooking as a way to kill bacteria, and even fewer depicted refrigeration or preservation as methods of retarding decomposition. Instead, most of the students spoke of cooking foods to make them taste better or improve their sensory qualities (e.g., soften them for easier chewing), depicted refrigeration as a method of keeping foods fresh and tasting good, and struggled to explain why some foods keep for a long time in bottles or cans without spoiling. Only five students made specific reference to killing germs or bacteria through cooking, although several others referred to "poison," "minerals," "diseases,"

"animal blood," or "stuff that could make a human sick" that is killed, boiled away, or otherwise eliminated through cooking.

Most of the students understood that foods eventually deteriorate (turn hard or yucky, turn green, get white stuff on them, etc.) and that careful wrapping and sealing, refrigeration, and other steps can be taken to preserve their freshness or edibility. However, only one student made reference to the process of decomposition, and only a few spoke of the actions of germs or bacteria. If they were able to offer any explanation at all for why refrigeration or bottling or canning preserves foods, their explanations typically emphasized protection from air or from insects. No student drew an explicit connection between temperature and decomposition/ spoilage rate.

Whether discussing refrigeration, food preservation methods of the past, or bottling or canning, the students who offered the most sophisticated responses tended to talk about keeping harmful things away from food, but to describe these harmful things as air or insects rather than germs or bacteria. The students had good practical knowledge (understanding that foods spoil and that steps such as refrigeration and careful wrapping or sealing can retard spoilage), based on observable features and events (foods gradually lose freshness and become stale, hard, or "yucky"), but few understood much about the causal mechanisms underlying these transformations. Those with no knowledge were unable to offer substantive explanations, those with beginnings of understanding spoke of protecting foods from insects, and those who were starting to develop more scientific understandings spoke of protecting foods from germs, bacteria, or things in the air. However, only the one student referred to decomposition and none explicitly noted that this process occurs more quickly at higher temperatures.

Responses to Questions 16 and 17 indicated that the students generally were quite knowledgeable about healthful vs. less healthful foods, although less knowledgeable about the reasons for these differences and less aware of sugar than of fat as a potentially problematic component of one's diet. Even the youngest students understood that fruits and vegetables are better for us than snack foods and desserts. However, even the third graders did not yet possess enough knowledge about body metabolism to be able to say much about why good foods are good for us or junk foods are bad for us.

Questions about land-to-hand transformations in bringing common foods to our tables indicated that the students knew much more about operations that they could observe at home (making bread or hamburgers) than processes that occur elsewhere (manufacturing cheese, grinding beef into hamburger meat). They also were better informed when the land-to-hand progressions involved fewer transformations of the physical appearance of the original foods, fewer combinations with other ingredients, and less processing.

More than two-thirds of the students understood that applesauce is basically crushed/ mushed apples, although only 21 noted that cooking is involved and only 21 mentioned ingredients other than apples (e.g., sugar, cinnamon). About half of the students knew that cheese is made from milk, but only 10 were able to say anything else about the process. Only a few students offered anything like an explanation, and several advanced misconceptions (e.g., cheese is made by freezing milk or that it is made from eggs or wheat). Two-thirds of the students were able to say something about the manufacture of bread, although only 21 provided a good explanation that included both (1) making dough from its ingredients and (2) baking the dough into bread. Furthermore, much of what many of the students had to say was oversimplified or distorted in some way. Only a few seemed to understand that flour is finely

ground wheat, and many thought that bread is made simply by grinding up grain and then cooking it. The progression of knowledge here seemed to be from knowing nothing at all to knowing that bread is made from grain but lacking further information about the processes involved, to knowing that flour is milled grain and the flour must be mixed with other ingredients to form dough and then baked into bread. Finally, fewer than half (39) understood that the meat in a hamburger comes from "cows" (only a few students spoke of beef or cattle), and their descriptions of the processes involved in creating a hamburger almost always omitted grinding the meat.

In general, responses to these "land-to-hand" questions confirmed previous findings that urban and suburban children tend to know very little about what occurs on farms because they lack direct personal experience with farming. We would add that children in the early grades have little awareness of food production and manufacturing as an industry. To the extent that they have clear images at all, they think in terms of small family farms on which people raise food in part (or even mostly) for their own consumption and sell the rest to the nearby food stores. They have little or no awareness of massive, corporately owned farms and ranches or of the networks of food manufacturing companies, food transportation systems, storage facilities, and supermarket chains involved in bringing foods to nearby stores.

Finally, like the responses to most of the questions in all of our interviews, the students' responses to land-to-hand progression questions indicated that although they possess practical knowledge about the general nature, appearance, and uses of things in their environment, they often have little knowledge of their essential nature (e.g., flour is milled grain, hamburger meat is ground beef) or the processes involved in manufacturing them. Typically, they either were unable to respond or else provided a response that was valid as far as it went but quite limited.

However, a few students articulated some interesting misconceptions when they attempted to elaborate: you have to add sauce or "taste of apple" to crushed apples in order to make applesauce; cheese is made by freezing milk or liquid cheese; you make bread by baking wheat directly or by cooking a mixture of water and "little pieces of bread;" hamburger meat comes from McDonald's or Burger King.

When asked why farmers raise chickens, cows, pigs, and sheep, majorities of the students were able to say that we get meat and eggs from chickens, milk and meat from cows, meat from pigs, and wool from sheep. The students generally knew more about products derived from chickens and cows than products derived from pigs and sheep. Only about one-fourth of the students noted that we also get meat from sheep, but there was little or no mention of tanning the hides of cattle or pigs to create leather products or of raising animals as a profit-making business.

The responses typically implied images of small family farms with small numbers of animals, sometimes known individually and treated as pets by family members. A few students spoke of certain forms of meat, especially "chicken," as if it were something other than flesh removed from dead animals. Among students who were aware that meats are flesh from dead animals, some were under the impression that the flesh is taken from the animals only after they have died natural deaths. Even third graders seemed unaware of feed lots, slaughter houses, and other "macro" aspects of meat production.

Questions 26 and 27 addressed students' awareness of the fact that production and labor costs add to the prices of food items. When asked why a pound of cereal costs more than a pound of apples, 38 could not respond and most of the rest gave responses such as that you get more cereal because it comes in a bigger box, the cereal lasts longer than the apples, the cereal box costs more than the bag that the apples come in, a toy or trinket is included with the cereal,

or cereal is better for you than apples. These students (a heavy majority) showed no awareness of the fact that the costs of processing manufactured foods add to the price of the final product.

Students' difficulties in answering Question 26 were compounded by confusions surrounding mass, volume, density, and related concepts. Many of them had difficulty retaining the idea that the cereal and the apples weighed the same because the larger size of the cereal box made it seem that there must be more cereal than apples. Only eight students stated directly that cereal is more expensive because it has to be manufactured, although a few other students implied this ideas in stating that cereal involves combining grain with other ingredients (e.g., sugar, marshmallows, honey, or food coloring).

The students were more successful in explaining why it costs more to eat a meal in a restaurant than it does to have the same meal at home. Even here, however, only a little more than a third of them said that this was because we have to pay the people who work there for cooking and serving the food.

The students were unusually successful in responding to the question about steps in growing corn. Two-thirds or more of them mentioned planting the seeds, watering the plants, waiting for the plants to mature, and then harvesting the corn. Smaller numbers of students mentioned preparing the soil, making sure that the plants get enough sunshine, fertilizing or spraying pesticides, shucking the corn after it is harvested, and clearing the field or plowing for the next planting. Most responses were valid as far as they went and free of misconceptions, probably reflecting information about plants learned in science classes. In addition, a few students provided detailed responses that had been informed by knowledge acquired outside of school, and a few communicated ideas probably learned in social studies (such as that Indians used fish as fertilizer).

The next question assessed students' awareness that possibilities for farming are affected by climate and geography, by asking students why there are lots of farmers in Michigan but not so many in Alaska. The majority of the students could not answer this question adequately. Of the rest, 26 said that it is too cold in Alaska to grow crops, 7 that it is too cold for animals to survive there, 7 that there is not enough sunlight there, and a few others that it lacks good soil. Once again we saw limitations in the students' knowledge about how geography and climate constrain human activities.

The final questions addressed students' knowledge about ways in which machines and other inventions have revolutionized farming. The kindergarteners and first graders had difficulty even responding to these question, but about half of the second and third graders generated responses that were valid as far as they went, and a few displayed considerable knowledge about modern farming. The students were more aware of tractors and other large machines as inventions that have helped farmers; only a few mentioned seeds, fertilizers, or sprays, and none mentioned crop rotation or other specific techniques. In attempting to explain why we need many fewer farmers per capita today than in the past, only 14 students specifically stated that machines multiply what a worker can accomplish in a day and none displayed awareness of the fact that modern farms are more productive not only because they are bigger but because they produce a greater yield per acre than farms in the past.

Grade Level Differences

Significant relationships with grade level were observed for 134 of the 218 coding categories shown in Table 1. Of the 134 significant relationships, 128 were for linear trends and the other 6 were for nonlinear relationships. Of the 128 linear trends, 124 can be summarized

simply by stating that the younger students were more likely to be unable to respond or to be coded in categories reflecting low-level responses, whereas the older students were more likely to be coded in categories reflecting sophisticated responses. The other four linear trends were positive relationships with grade level for responses that were not actually correct but represented good guesses by students who lacked the knowledge needed to make an informed response to the question. These responses, although not as sophisticated as the best responses, were more sophisticated than those coded in alternative categories for failures to respond or more obviously incorrect responses. Overall, then, the data show consistent tendencies for increases in knowledge across the K-3 grade level range.

Achievement Level and Gender Differences

Only about a fourth (57) of the 218 categories showed significant relationships with achievement level. Of these, 48 were linear trends and 9 were nonlinear relationships. Of the 48 linear trends, 44 could be summarized simply by stating that lower achievers were more likely to be unable to respond or to give low-level responses to the questions, whereas higher achievers were more likely to give sophisticated responses. Of the remaining four linear trends, one was a positive relationship for achievement level for one of the "good guess" response categories that also showed a positive relationship with grade level. However, the other three linear trends were surprising, at least at first: Higher achievers were more likely than lower achievers to say no to Question 6 (i.e., to say that everyone everywhere eats the same foods) and to say that hamburger meat comes from animals other than cows, whereas lower achievers were more likely than higher achievers to say that good foods are good for us because they do not have fats or sugars (a generally valid response that showed a positive relationship with grade level).

Thus, in these three instances, the higher achievers were more likely to make inaccurate responses or the lower achievers more likely to make valid ones. However, we believe that only the last contrast constitutes a genuine exception to the general tendency for higher achievers to produce more sophisticated responses than lower achievers. Higher achievers may have been more likely than lower achievers to say that people eat the same foods everywhere and that hamburger meat comes from animals other than cows because they were more aware of diffusion of popular foods and of the availability of "burgers" made from meats or meat substitutes that do not include beef.

As with our previous studies, analyses of group differences indicated that statistically significant relationships appeared much more often with grade level than with achievement level, and these relationships were more often linear trends that proved to be easily interpretable. Also replicating our earlier findings was the fact that significant relationships appeared least frequently with gender. In this case, only 25 of the 218 categories in Table 1 showed a significant relationship with gender. Of these, 16 favored the boys and 9 favored the girls (in the sense that the "favored" gender was more able to respond to the question, made fewer lower level responses, or made more higher level responses). These gender differences not only were infrequent but failed to hang together to form clear patterns indicating that the boys knew more about certain aspects of the topic and the girls knew more about other aspects. Consequently, we decline to interpret the gender differences beyond noting that many of them seem related to a greater willingness on the part of the boys to guess when they lacked informed knowledge.

Limitations of the Study

Our interviewers generally established good rapport with students and our questions were tailored for the age levels involved, so we believe that our findings comprise a generally valid representation of the nature and development of K-3 students' knowledge and thinking about food as a cultural universal. Some of the students might have been more responsive if they had been interviewed on another day, and all of them might have been able to say more if we had included more illustrations to provide visual. However, illustrations usually were not needed because we were asking the children about issues with which they had had personal experience, so verbal questions alone usually were sufficient to enable them to understand what we were asking. Also, we have found that illustrations tend to "stimulus bind" children's responses, and we prefer them to respond using their own images of the objects, events, or processes we ask them about, not images that we might supply by showing them a photo or other illustration.

The sample was large enough to allow population differences by grade level, achievement level, or gender to be detected via statistically significant Chi-squares in our analyses. However, it was limited in at least three respects. First, it was limited to the lower middle portion of the socioeconomic status (SES) range. No subsamples representing the upper or lower SES levels were included.

Second, even though the sample was open to students of any race or ethnicity (as long as all or at least most of their lives had been lived in the U.S.), the population of the community involved was such that the students we interviewed were overwhelmingly European American in their ethnic composition. Few students from African-American, Asian-American, Latino, or Native American families were included. We believe that children's ideas about food are more likely to be influenced by their common experiences growing up within the contemporary U.S.

society and culture than by differences in their family backgrounds, so we do not believe that this sample limitation is as serious as it might have been if we were asking questions about race or ethnicity. This is an untested assumption, however, and it remains to be seen whether our findings will generalize to racial and ethnic minorities.

The third limitation in the sample was geographic. The students all lived in Michigan. It is possible that somewhat different patterns of response to at least some of our questions might have been elicited from students living elsewhere.

Another limitation of the study is its lack of systematic data on the origins of students' ideas. Interviewers were instructed to ask students about where they got their information when they gave unusually sophisticated or detailed responses, but we did not routinely ask about the sources of the students' information. This was because we view the work as initial, establishing-the-parameters research in an emerging field, rather than as more specifically targeted research in a more mature field. We are trying to establish initial norms or parameters concerning five-to-eight-year-old American children's knowledge and thinking about cultural universals, not to trace the origins of the knowledge, to establish the mechanisms through which development occurs, or to address other issues that might become more relevant farther down the road. This "outline the big picture first, then start filling in the details" approach is the way that science normally proceeds in emerging fields.

We assume that particular subsets of knowledge and thinking are developed through a mixture of mechanisms that will vary with the topic. For example, a lot of spontaneous knowledge development probably occurs in learning about aspects of cultural universals that are observable in the home and neighborhood. In contrast, most of what is learned about aspects that existed in the past or currently exist only in other areas or cultures would have to be learned

primarily through transmission of knowledge (initially from family members and the media, later at school). Eventually we will learn more about the mechanisms through which knowledge is acquired, what experiences lead to growth or change outside of school, how easy or difficult it may be to teach particular networks of knowledge in school, and what materials and methods may be helpful in doing so. [We suspect, for example, that children's literature and television (especially commercials) are more important influences on children's ideas about food than on their ideas about clothing or shelter.]

Implications for Primary-Grade Social Studies

In the introduction to this report we noted that Ravitch and others have claimed that primary-grade students do not need to be taught about cultural universals because they already know this information, having picked it up through everyday life experiences. This may be true for the very limited and trite information contained in many primary-grade social studies textbooks. We have no doubt that most children do develop intuitive understandings of these ideas through informal life experiences, and further that those who have not developed the ideas on their own are likely to understand them readily when they are pointed out by a teacher.

However, the findings of this study indicate clearly that children do not routinely acquire all, or even a significant portion, of what is worth knowing about cultural universals through everyday experiences (primarily because these experiences are informal and do not include sustained discourse structured around key ideas). Furthermore, the mostly tacit knowledge that they do accumulate is limited, disconnected, and frequently distorted by naïve ideas or outright misconceptions. We conclude from this that primary-grade students do stand to benefit from instruction about cultural universals, although the kind of instruction that we envision is much

more coherent and powerful than the kind that students are likely to receive from teachers who confine themselves to the content in the major publishers' elementary social studies textbook series and the questions and activities suggested in the accompanying teachers' manuals.

We believe that such instruction belongs in the primary-grades social studies curriculum, although in addition to (not instead of) efforts to develop students' prosocial values and dispositions and a variety of skills ranging from map reading to critical thinking and decision making. The questions asked in this study reflect our notions about key ideas that might be emphasized in teaching about food. Some of them might be classified more readily as science than social studies, but they all tap networks of knowledge that we believe to be basic for developing initial understandings of the topic. Like others who have focused on the primary grades, we believe that the curriculum in these grades should feature pandisciplinary treatments of topics designed to develop "knowledge of limited validity" (Levstik, 1986) or "protodisciplinary knowledge" (Gardner & Boix-Mansilla, 1994) about the topic, rather than attempts to teach children disciplinary knowledge organized as such.

We favor an appropriate balance between the three traditional sources of curricula (knowledge of enduring value, including but not limited to disciplinary knowledge; the students' needs, interests, and current zones of proximal development; and the needs of society in terms of the knowledge, skills, values, and dispositions that our society would like to see developed in future generations of its citizens). Within this context, we argue that a pandisciplinary introduction to the social world (past and present, taught with emphasis on developing understanding, appreciation, and life application of big ideas) makes more sense for primary-grade students than what we view as premature attempts to socialize these students into the academic disciplines.

In conclusion, we believe that primary-grade students stand to benefit considerably from treatments of cultural universals that are more powerful than those typically offered by textbook series. We define powerful treatments as treatments that enable students to develop understanding of how the cultural universal addressed in the unit works in our society, how and why it got to be that way over time, how it varies across locations and cultures, and what all of this might mean for personal, social, and civic decision making. Units offering such

Such units would still focus on elementary and familiar content in that they would address fundamental aspects of the human condition and connect with experience-based tacit knowledge that students already possess. However, they would not merely reaffirm what students already know. Instead, they would raise students' consciousness of and help them to construct articulated knowledge about basic aspects of the cultural universal that they have only vague and tacit knowledge about now (aspects that are concrete and comprehensible to them given their limited cognitive structures and prior knowledge; aspects that were too abstract or macroanalytic would not be included). Such units also would introduce students to a great deal of new information, develop connections to help them transform scattered understandings into a network of integrated knowledge, and stimulate them to apply the knowledge to their lives outside of school and to think critically and engage in value-based decision making about the topic. For more information about such units, see Brophy and Alleman (1996), and for detailed unit plans, see Alleman and Brophy (2001, in press a, in press b). The Alleman and Brophy (in press b) volume includes plans for an instructional unit on communication.

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APPENDIX A

FOOD INTERVIEW

1. **PEOPLE ALL OVER THE WORLD EAT FOOD. IS THAT JUST BECAUSE THEY LIKE TO, OR DO THEY NEED FOOD? . . . WHY? . . . WHAT DOES FOOD DO FOR US?**

2. **WHAT IS FOOD? . . . HOW IS FOOD DIFFERENT FROM OTHER THINGS THAT ARE NOT FOOD?** (

   (If necessary to clarify or elaborate the student's initial response, ask WHAT DOES FOOD HAVE THAT OTHER THINGS DON'T HAVE? or ARE THERE THINGS WE CAN EAT THAT ARE NOT FOOD?)

3. **SCIENTISTS TALK ABOUT DIFFERENT FOOD GROUPS. HAVE YOU HEARD OF FOOD GROUPS?** (If yes, probe for examples.)

4. **THINK ABOUT THE FOODS THAT PEOPLE ATE ABOUT 80 YEARS AGO, AROUND 1920. DO WE HAVE FOODS TODAY THAT THEY DIDN'T HAVE IN 1920?** (Probe for examples and explanations--e.g., ask WHY DIDN'T THEY HAVE _____ BACK THEN?)

5. **BACK THEN, DID THEY EAT SOME FOODS THAT WE DON'T EAT TODAY?** (Probe for examples and explanations--e.g., ask WHY DON'T WE EAT _____ TODAY?)

6. **ARE THERE SOME COUNTRIES WHERE PEOPLE EAT DIFFERENT FOODS THAN WE EAT?** (Probe for examples and explanations--e.g., ask WHAT DO THEY EAT THAT WE DON'T EAT? and WHAT DO WE EAT THAT THEY DON'T EAT?)

7. **THINK ABOUT JAPAN. DO THE JAPANESE PEOPLE EAT DIFFERENT FOODS THAN WE DO?** (If yes, ask for examples and explanations--e.g., ask WHAT THINGS DO THE JAPANESE PEOPLE EAT THAT WE DON'T EAT? and WHAT THINGS DO WE EAT THAT THE JAPANESE PEOPLE DON'T EAT?)

   (If the student talks about chopsticks or other eating rituals, acknowledge this response but then get back to foods--e.g., ask OK, BUT DO THE JAPANESE PEOPLE EAT DIFFERENT FOODS THAN WE DO?)

8. **SOME FOODS THAT WE EAT NOW WERE BROUGHT HERE TO AMERICA BY PEOPLE WHO CAME FROM OTHER COUNTRIES. WHAT ARE SOME OF THESE FOODS THAT WERE BROUGHT HERE FROM OTHER COUNTRIES?**

9. **AMERICAN PEOPLE EAT A LOT OF BEEF, BUT CHINESE PEOPLE EAT A LOT OF CHICKEN. WHY IS THAT?** (If the student's response amounts to "Because they like to," probe for a more substantive explanation--e.g., ask IS THERE SOME OTHER REASON WHY AMERICANS EAT MORE BEEF BUT CHINESE EAT MORE CHICKEN?)

10. **AMERICAN PEOPLE EAT A LOT OF BREAD, BUT CHINESE PEOPLE EAT A LOT OF RICE. WHY IS THAT?** (If the student's response amounts to "Because they like to," probe for a more substantive explanation--e.g., ask IS THERE SOME OTHER REASON WHY AMERICANS EAT MORE BREAD BUT CHINESE EAT MORE RICE?)

11. **WE EAT SOME FOODS RAW, BUT WE COOK MEATS AND MANY VEGETABLES BEFORE WE EAT THEM. WHY DO WE COOK THESE FOODS?** (Probe for as many reasons for cooking as the student is able to provide--e.g., ARE THERE OTHER REASONS FOR COOKING SOME FOODS? If necessary, ask HOW DOES COOKING MAKE THESE FOODS BETTER FOR US TO EAT? or WHAT DOES COOKING DO TO THESE FOODS?)

12. **WE EAT MANY VEGETABLES AND MOST FRUITS RAW. WHY DON'T WE COOK THESE FOODS?** (Probe for as many reasons as the student can give.)

13. **WE PUT MANY FOODS IN THE REFRIGERATOR TO KEEP THEM COLD. WHY DO WE DO THAT?** (Probe for examples and explanations--as many different reasons for refrigeration as the student can provide--e.g., ARE THERE OTHER REASONS FOR REFRIGERATING SOME FOODS?)

14. **BEFORE ELECTRICITY WAS DISCOVERED, PEOPLE DIDN'T HAVE REFRIGERATORS. WHERE DID THEY KEEP THEIR FOODS THEN? . . . HOW DID THEY PRESERVE FOODS TO KEEP THEM FROM SPOILING?** (If it is not clear how a method mentioned by the student would aid in food preservation, ask HOW DID THIS KEEP FOODS FROM SPOILING?)

15. **SOME FOODS KEEP FOR A LONG TIME IN BOTTLES OR CANS WITHOUT SPOILING. WHY IS THAT?** (If the student says something like "Because they are closed up," probe for an explanation of why this fosters preservation--e.g., ask HOW DOES THAT KEEP THE FOOD FROM SPOILING?)

16. **CERTAIN FOODS ARE HEALTHFUL AND NUTRITIOUS. WHAT ARE SOME OF THESE FOODS THAT ARE ESPECIALLY GOOD FOR YOU?** (If student can supply examples, ask WHY ARE THESE FOODS GOOD FOR YOU?)

17. **OTHER FOODS--OFTEN CALLED JUNK FOODS--ARE NOT VERY HEALTHFUL OR NUTRITIOUS. WHAT ARE SOME OF THESE JUNK FOODS?** (If student supplies examples, ask WHY ARE THESE FOODS NOT SO GOOD FOR YOU?)

18. **LET'S TALK ABOUT HOW WE GET DIFFERENT FOODS. WE'LL START WITH APPLESAUCE. HOW IS APPLESAUCE MADE?** (If student gives only a partial explanation, probe by asking TELL ME MORE ABOUT THAT or HOW DO THEY GET FROM APPLES TO APPLESAUCE? or WHAT'S THE FIRST STEP? . . . THEN WHAT? . . . ETC.)

19. **HOW IS CHEESE MADE?** (If the student says that cheese comes from cows/milk, ask HOW DO YOU GET FROM COWS/MILK TO CHEESE? If the student gives only a partial explanation, probe by asking TELL ME MORE ABOUT THAT or WHAT'S THE FIRST STEP? . . . THEN WHAT? . . . ETC.).

20. **HOW IS BREAD MADE?** (If student says that bread comes from wheat, grain, etc., ask HOW DO YOU GET FROM WHEAT TO BREAD? If the student gives only a partial explanation, probe by asking TELL ME MORE ABOUT THAT or WHAT'S THE FIRST STEP? . . . THEN WHAT? . . . ETC.)

21. **HOW IS THE MEAT IN A HAMBURGER MADE?** (If student says that the meat comes from cows, pigs, etc., ask HOW DO YOU GET FROM COWS TO HAMBURGER MEAT? If student gives only a partial explanation, probe by asking WHAT'S THE FIRST STEP? . . . THEN WHAT? . . . ETC.)

22. **MANY FARMERS RAISE CROPS, BUT OTHERS RAISE ANIMALS. FOR EXAMPLE, SOME FARMERS RAISE CHICKENS. WHY DO THESE FARMERS RAISE CHICKENS?** If necessary, probe by asking WHAT DO WE GET FROM CHICKENS? or WHAT ELSE DO WE GET FROM CHICKENS?

23. **SOME FARMERS RAISE COWS. WHAT DO WE GET FROM COWS? . . . WHAT ELSE DO WE GET FROM COWS?**

24. **SOME FARMERS RAISE PIGS. WHAT DO WE GET FROM PIGS? . . .** WHAT ELSE DO WE GET FROM PIGS? WHAT DO WE CALL THAT MEAT?

25. **SOME FARMERS RAISE SHEEP. WHAT DO WE GET FROM SHEEP?** . . . WHAT ELSE DO WE GET FROM SHEEP?

    If the student only mentions wool or cloth from sheep, ask DO WE GET MEAT FROM SHEEP? . . . WHAT DO WE CALL THIS MEAT WE GET FROM SHEEP?

26. **A POUND OF CEREAL COSTS MORE THAN A POUND OF APPLES. WHY IS THAT?** (If the student says that there is more cereal, say NO, THEY ARE BOTH A POUND, SO THE AMOUNT IS THE SAME. WHY DO WE HAVE TO PAY MORE FOR THE CEREAL THAN THE APPLES?)

27. **IT COSTS MORE TO EAT A MEAL IN A RESTAURANT THAN IT DOES TO HAVE THE SAME MEAL AT HOME. WHY IS THAT?** (If the student says only

that you have to buy your food in the restaurant, point out that you have to buy the food you eat at home, too. Clarify that you have to pay more to eat the same food at the restaurant than you would have to pay to eat it at home, and then press for an explanation.)

28. **MANY FARMERS GROW CORN. TELL ME ABOUT THE STEPS THAT FARMERS GO THROUGH TO GROW CORN.** (Allow the student to make an extended statement in his/her own words. If necessary, help get the student started by asking WHAT DOES THE FARMER DO FIRST? . . . THEN WHAT? . . . NEXT? etc.]

Probe for the cycle of planting, nurturing, harvesting, and clearing/fallow/rotation. Then ask the following, more specific, probes.)

a. (Planting): HOW DOES THE FARMER PLANT THE CORN?

b. (Nurturing): WHAT DOES THE FARMER DO AFTER THE CORN IS PLANTED? . . . DOES THE FARMER HAVE TO DO ANYTHING BESIDES WATERING THE CORN?

c. (Harvesting): WHAT DOES THE FARMER DO WHEN THE CORN IS READY?

d. (Clearing/fallow/rotation): AFTER THE CORN IS PICKED AND TAKEN AWAY, WHAT DOES THE FARMER DO BEFORE PLANTING NEXT YEAR'S CROP?

29. **THERE ARE LOTS OF FARMERS AROUND HERE, BUT THERE ARE NOT MANY FARMERS UP IN ALASKA. WHY NOT?** (If student responds in some way that fails to mention the cold climate being unsuitable for farming, probe by asking ARE THERE OTHER REASONS WHY THERE IS NOT MUCH FARMING IN ALASKA?)

30. **HOW IS FARMING TODAY DIFFERENT FROM FARMING 100 YEARS AGO?** (Probe for clarifications or explanations if necessary.)

31. **WHAT ARE SOME INVENTIONS THAT HAVE HELPED FARMERS?** (If necessary, stimulate response by asking DO TODAY'S FARMERS HAVE FARMING TOOLS AND METHODS THAT WERE NOT AVAILABLE TO FARMERS 100 YEARS AGO?)

32. **LONG AGO, MOST PEOPLE HAD TO BE FARMERS IN ORDER TO PRODUCE ENOUGH FOOD TO FEED EVERYONE. BUT TODAY, ONLY A FEW FARMERS PRODUCE ALL THE FOOD WE NEED. WHY IS THAT?** (Probe for explanations. If the student's initial response focuses on the development of other kinds of jobs or in some other way fails to address the increased productivity of

farms, say OK, BUT HOW ARE TODAY'S FARMERS ABLE TO PRODUCE SO MUCH MORE FOOD THAN BEFORE?)

food/draft-4.wp

Table 1. Distributions and Correlation Coefficients Showing Relationships of Coding Categories to Grade Level, Achievement Level, and Gender[1]

	Total Sample	Grade Frequencies K	1	2	3	Grade Phi	Achievement Level Frequencies Low	Avg.	High	Ach. Phi	Gender Frequencies M	F	Gender Phi
Number of Students	**96**	**24**	**24**	**24**	**24**		**32**	**32**	**32**		**48**	**48**	
1. Why do people need food? . . . What does food do for us?													
0. Doesn't know/ no relevant response	6	5	1	0	0	-36	1	3	2		2	4	
1. Food provides energy or fuel	13	0	2	6	5	29	2	4	7	19	7	6	
2. To avoid starvation, death; to stay alive	68	10	20	19	19	37	22	20	26		39	29	-23
3. To grow (no further explanation)	16	5	2	3	6		6	6	4		8	8	
4. To be healthy (no further explanation)	27	3	8	10	6		12	7	8		13	14	
5. Food provides strength or assists body functioning (helps grow bone or muscle)	10	3	1	1	5		2	5	3		5	5	
2A. What is food?													
0. Doesn't know/no relevant response	18	9	6	3	0	-36	5	6	7		10	8	

Table 1 (cont'd.)

1. Lists food items without defining food	21	5	4	4	8		11	5	5	-21	12	9		
2. Food is something that people eat	54	8	12	18	16	32	16	20	18		26	28		
3. Other (response not codable in other categories)	16	1	2	3	10	40	5	3	8		5	11		17
4. Food is good for you, makes you healthy, contains things good for the body, etc.	12	3	2	5	2		4	3	5		6	6		

2B. How is food different from things that are not food?

0. Doesn't know/no relevant response	31	13	8	7	3	-32	11	8	12		14	17		
1. Lists nonessential food characteristics (looks like food, doesn't walk, not hard, has seeds, etc.)	16	3	1	4	8	29	4	8	4		7	9		
2. Food is healthy, good for you (no further explanation)	10	2	4	3	1		4	3	3		3	7		
3. Food has taste/tastes different from non-food	14	3	0	5	6	27	6	5	3		6	8		

Table 1 (cont'd.)

4. Food is eaten, non-food items are not eaten	25	2	11	4	8	NL	6	14	5	NL	13	12
5. Food provides health benefits, contains vitamins and minerals, etc.	11	0	2	3	6	28	2	5	4		5	6
6. Lists food and nonfood examples (candy, bugs, flowers, rocks, etc.)	21	3	4	6	8	19	9	4	8		8	13
8. At some point in responding to the first two questions, the student describes food as a source of energy for the body	14	1	2	5	6	24	3	4	7		7	7
3. What are some of the food groups?												
0. Cannot list any food groups	34	17	9	2	6	-48	13	11	10		16	18
1. Lists food items (cheese apples, pears) or unconventional food groups (purple, green, etc.; breakfast/lunch dinner; meat/deli/fruit)	20	5	3	7	5		7	5	8		12	8
2. Lists one, two, or three conventional food groups	29	3	12	8	6	NL	8	16	5	NL	18	11

Table 1 (cont'd.)

3. Lists four or more conventional food groups	25	0	3	12	10	47	8	5	12		11	14
4. Do we have foods today that they didn't have in 1920? . . . Why didn't they have those things back then?												
0. Doesn't know/no relevant response	15	7	5	1	2	-27	8	5	2	-21	7	8
1. No—there are no foods now that they didn't have in 1920	14	6	3	2	3		7	3	4		6	8
2. Says yes but cannot explain for give examples	14	5	4	4	1		3	6	5		5	9
3. Incorrectly lists foods that were available in 1920	47	5	12	15	15	34	10	17	20	26	27	20
4. Correctly lists foods that were not available in 1920 (fast food, pizza, junk foods, candies, etc.)	19	1	2	8	8	34	7	4	8		11	8
5. The foods existed but were not available locally (chocolate)	6	0	1	2	3	19	1	0	5	28	4	2
6. The foods were unavailable because they hadn't been invented yet	12	1	1	4	6	27	3	3	6		6	6

Table 1 (cont'd.)

7. The foods were unavailable because people didn't know how to make them or lacked the technological capabilities to do so	17	0	5	6	6	27	5	6	6		10	7
5. Back then did they eat some foods that we don't eat today?												
1. No—they ate the same foods that we eat	18	8	2	3	5		5	7	6		10	8
2. Says yes but cannot give examples	36	4	12	11	9	NL	10	13	13		16	20
3. Incorrectly lists foods still eaten today	12	2	6	3	1		4	3	5		6	6
4. Mentions a food not typically eaten today, although still available (buffalo, squash/gourds, brains, molasses)	16	1	1	6	8	35	6	5	5		9	7
6. Are there some countries where people eat different foods than we eat? . . . What do they eat? . . . What do we eat that they don't eat?												
0. Doesn't know/no relevant response	13	6	5	2	0	-29	5	5	3		5	8
1. No—everyone else eats the same foods	6	2	1	3	0		0	2	4	21	2	4

Table 1 (cont'd.)

2. Says yes or lists countries but gives no examples	36	10	8	10	8		15	12	9		19	17		
3. Lists American foods that people in other countries presumably do not eat (common meats and sandwiches, junk food, fruit, vegetables, cereals, etc.)	22	4	5	5	8		6	7	9		15	7		-20
4. (For those coded 3) Mentions one or more typical American food that actually is not eaten in many places (peanut butter, packaged cereals, hot dogs)	12	1	2	2	7	30	5	2	5		7	5		
5. They eat exotic or questionable foods (cheetahs, tigers, spiders, slugs, snow)	7	1	4	1	1		4	2	1		4	3		
6. They eat generic ethnic foods (Chinese, Italian food)	9	1	3	1	4		5	1	3		7	2		-18

Table 1 (cont'd.)

7. Lists specific foods conventionally associated with other countries (hot peppers, egg rolls, pizza, Chinese chicken dishes, fortune cookies, French bread)	27	2	5	7	13	37	5	10	12	20	13	14		

7. Do the Japanese people eat different foods than we do? What do the Japanese people eat? . . . What do we eat that the Japanese people don't eat?

0. Doesn't know/no relevant response	10	3	2	4	1		4	2	4		5	5		
1. No—we eat the same foods	6	3	2	1	0	-19	3	2	1		4	2		
2. Says yes but cannot explain or give examples	15	7	5	1	2	-27	3	6	6		4	11		20
3. Americans eat candy and other processed junk foods	15	1	3	6	5	22	1	8	6	25	8	7		
4. Americans eat fruits and vegetables or Japanese people do not	32	6	9	9	8		15	9	8	-20	17	15		
5. Americans eat family meal food (macaroni and cheese, steak and mashed potatoes, chicken, barbecue, pizza, ravioli)	33	6	8	7	12	20	11	10	12		17	16		

Table 1 (cont'd.)

6. Lists conventional Japanese foods (noodles, rice, fish, sushi, tofu)	22	3	2	5	12	39	3	8	11	25	10	12
7. (If coded 3, 4, or 5): Lists one or more American foods that Japanese people ordinarily would not eat	40	7	10	9	14	22	13	14	13		20	20
8. What foods that we eat now were brought to America from other countries?												
0. Doesn't know/no relevant response	30	13	8	4	5	-32	13	13	4	-29	12	18
2. Generic or common foods (fruit, meat, milk apples, etc.)	31	7	6	14	4	NL	10	9	12		18	13
3. Crops or foods of the Americas (corn, tomatoes, turkey, peanuts, pumpkins)	18	2	3	7	6	22	6	7	5		7	11
4. Crops originating in other countries (rice, bananas)	17	0	4	7	6	29	4	5	8		8	9
5. Dishes originating in other countries (crab Rangoon, tacos, spaghetti, goulash)	22	2	5	7	8	23	4	7	11	21	11	11
6. Is coded either 4 or 5	33	2	9	11	11	33	8	10	15	19	16	17

Table 1 (cont'd.)

9. American people eat a lot of beef but Chinese people eat a lot of chicken. Why is that?

0. Doesn't know/no relevant response	28	12	6	4	6	-28	11	11	6		13	15
1. Simply because they are different people	14	5	5	1	3		4	4	6		9	5
2. Chinese people like chicken but Americans like beef	35	6	10	10	9		13	13	9		17	18
3. Chinese people have more access to chicken or raise more chickens, Americans raise more beef/cattle	29	3	5	11	10	30	8	6	15	26	14	15
4. Chinese people do not know anything about beef or do not know how to cook it	6	0	2	2	2		2	0	4		2	4

10. American people eat a lot of bread but Chinese people eat a lot of rice. Why is that?

0. Doesn't know/no relevant response	31	11	9	6	5	-21	11	8	12		15	16
1. Simply because they are different people	14	5	4	2	3		5	3	6		6	8
2. Chinese people like rice, Americans like bread	31	7	7	8	9		9	13	9		16	15

Table 1 (cont'd.)

3. Chinese people have greater access to rice, grow more rice, Americans more wheat/ bread	33	3	6	8	16	42	11	10	12		16	17

11. We eat some vegetables raw, but we cook meats and many vegetables before we eat them. Why do we cook these foods?

0. Doesn't know/no relevant response/"for health" (unexplained)	9	7	0	1	1	-40	1	5	3		5	4
1. To soften the foods; so they will be easier to eat, won't break your teeth	24	3	7	9	5		11	7	6		13	11
2. So eating the foods will not make you sick; to kill germs or bacteria	26	3	7	7	9	20	7	7	12		12	14
3. So they will taste better	55	11	12	13	19	26	17	20	18		27	28
4. So they will be warm or hot when we eat them	39	6	11	13	9		13	13	13		19	20

12. We eat many vegetables and most fruits raw. Why don't we cook these foods?

0. Doesn't know/no relevant response	13	7	4	2	0	-32	7	4	2	-19	8	5
1. "Other" responses not coded in the following categories	8	1	1	2	4	19	0	3	5	23	3	5

Table 1 (cont'd.)

2. People don't want to cook them; don't like them cooked; like to eat them raw	9	1	3	3	2		4	4	1		3	6
3. These foods are not supposed to be cooked	20	3	7	5	5		8	6	6		10	10
4. These foods don't need to be cooked	24	6	4	8	6		9	9	6		9	15
5. These foods taste good already; cooking will make them taste bad	29	4	4	11	10	30	6	10	13	20	12	17
6. The current state of these foods is OK; they are already good	18	5	1	3	9	NL	2	8	8	23	8	10
7. Cooking these foods will change them in an undesirable way (gross, yucky, too hot, burned, melted, not fresh)	21	3	6	7	5		6	7	8		13	8
8. Eating these foods cooked can make people sick	6	1	2	1	2		3	1	2		2	4
13. We put many foods in the refrigerator to keep them cold. Why do we do that?												
0. Doesn't know/no relevant response	9	5	2	2	0	-26	4	3	2		3	6

Table 1 (cont'd.)

1. Some foods need to stay cold (unexplained further – no codes in 2-6)	11	5	4	0	2	-25	4	4	3		8	3	
2. To save the foods for later; keep leftovers	11	2	4	3	2		3	2	6		4	7	
3. To keep the foods tasting good	19	5	2	7	5		3	10	6	NL	7	12	
4. To keep the foods from melting	17	3	4	4	6		4	6	7		9	8	
5. To keep the foods fresh; keep them from getting stale/rotten/ yucky	52	5	12	18	17	43	17	17	18		25	27	
6. To keep them from making people sick	17	0	3	5	9	36	6	6	5		12	5	-19

14. Before electricity was discovered, people didn't have refrigerators. Where did they keep their foods then?

0. Doesn't know/no relevant response	26	9	11	4	2	-34	11	9	6		10	16	
1. In storage places or cold places (no further explanation)	10	1	4	3	2		2	4	4		8	2	-20
2. In cupboards or a pantry	19	8	3	5	3		4	9	6		8	11	

Table 1 (cont'd.)

3. In cold water	9	4	2	3	0	-21	4	1	4	5	4
4. On ice or in ice boxes	27	1	3	7	16	53	7	8	12	14	13
5. Outside	18	1	4	6	7	25	7	6	5	11	7
7. Other (underground, cooked it or ate it quickly, protected it from bugs, covered or wrapped the food)	16	1	1	9	5	37	3	6	7	8	8
15. Some foods keep for a long time in bottles or cans without spoiling. Why is that?											
0. Doesn't know/no relevant response	56	22	18	12	4	-57	24	17	15	27	29
1. Bottles and cans are cold or retain cold	7	1	2	0	4		2	4	1	2	5
2. Bottles and cans are closed (no further explanation)	10	1	2	2	5	21	1	5	4	5	5
3. Bottles and cans are closed so that no air/ nothing can get to the food	14	0	1	7	6	36	4	3	7	9	5
16. Certain foods are healthful and nutritious. What foods are especially good for you?											
1. Lists one or more foods that are not nutritious	6	0	3	2	1		1	3	2	3	3

Table 1 (cont'd.)

2. List specific nutritious foods other than fruits and vegetables	37	11	11	8	7		15	10	12		20	17			
3. Lists specific fruits or vegetables	66	17	18	17	14		26	18	22	NL	33	33			
4. Lists categories of food or food groups	45	5	14	14	12	31	12	18	15		24	21			
16B. Why are these foods good for you?															
0. Doesn't know/no relevant response	17	10	5	1	1	-40	6	5	6		11	6			
1. They keep you healthy	24	3	8	7	6		9	10	5		7	17	24		
2. They make you strong	6	0	2	3	1		2	2	2		2	4			
3. They help you grow/ make you big	11	4	3	2	2		3	3	5		5	6			
4. They help specific parts of the body: heart, teeth bones, etc.	11	2	2	3	4		3	3	5		5	6			
5. They give you energy	8	0	1	3	4	24	1	3	4		2	6			
6. They do not have fats or sugars	8	1	1	2	4	19	5	3	0	-23	4	4			
7. They contain healthy stuff/nutrition	21	5	4	7	5		9	8	4		10	11			

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Table 1 (cont'd.)

8. They contain vitamins, minerals, proteins, fiber, etc.	18	1	2	7	8	33	3	7	8		10	8		

17A. Other foods are not very healthful or nutritious. What are some of these junk foods?

1. Candy, gum, chocolate, potato chips (snack foods)	79	11	22	23	23	55	27	24	28		41	38		
2. Pop/soda	9	0	3	3	3		1	5	3		4	5		
3. Ice cream/milk shakes	19	6	4	5	4		6	6	7		5	14		24
4. Heavy fried or fatty foods (burgers, bacon, pizza, French fries	7	0	2	2	3		3	1	3		5	2		
5. Baked dessert foods (cakes, cookies, brownies, donuts)	25	7	3	5	10		4	11	10	22	12	13		
6. Sugar/honey	9	1	4	2	2		2	4	3		4	5		
8. Other (bones, alcohol, seaweed, peanut butter and jelly, fish, butter, caffeine)	9	3	2	1	3		7	1	1	-30	7	2		-18

17B. Why aren't these foods good for you?

0. Doesn't know/no relevant response	16	7	7	2	0	-35	5	5	6		7	9		

Table 1 (cont'd.)

1. They don't keep you healthy/make you strong	12	2	3	1	6		1	9	2	NL	3	9	19
2. Bad for your teeth, give you cavities, rot your teeth	21	5	5	5	6		7	7	7		11	10	
3. Have a lot of sugar	36	6	4	12	14	36	12	10	14		18	18	
4. Have a lot of fat	15	2	1	3	9	36	5	3	7		6	9	
6. Make you hyperactive	6	0	0	1	5	36	0	1	5	28	2	4	
7. Make you sick or could make you die	16	4	3	5	4		7	3	6		5	11	17
8. Lack "healthy stuff" in them (vitamins, protein, nutrients, etc.)	17	2	5	6	4		3	8	6		11	6	
18. How is applesauce made?													
0. Doesn't know/no relevant response	8	6	2	0	0	-37	5	2	1	-19	7	1	-23
1. You need apples (no further explanation)	6	3	0	3	0		3	3	0		1	5	17
2. Crush, mush, stir apples	67	11	15	20	21	37	18	24	25	21	34	33	
3. Cut up apples	16	3	7	2	4		6	6	4		8	8	
4. Remove peel, core, seeds	22	3	5	7	7		5	7	10		9	13	

Table 1 (cont'd.)

5. Cook apples	21	2	7	4	8	24	5	3	13	33	6	15	23
6. Add other ingredients (sugar, water, cinnamon, sauce, butter)	21	3	7	6	5		7	4	10		12	9	
7. Use an appliance (mixer, blender, machine in factory to crush apples)	19	2	3	6	8	25	4	8	7		10	9	
8. Store the applesauce in a container or refrigerator	20	4	4	7	5		5	9	6		11	9	
19. How is cheese made?													
0. Doesn't know/no relevant response	46	18	13	9	6	-38	20	15	11	-23	18	28	21
1. It's made from milk	40	4	9	11	16	36	11	15	14		27	13	-30
2. Adds something acceptable to the idea that it's made from milk (the milk has to be stirred or mixed, the material needs to be pressed into the shape of cheese, etc.)	10	2	2	4	2		1	2	7	27	3	7	
20. How is bread made?													
0. Doesn't know/no relevant response	30	13	9	5	3	-35	13	9	8		14	16	
2. Made from dough	16	5	4	3	4		2	8	6		7	9	

Table 1 (cont'd.)

3. Made from grain (wheat, corn, etc.)	41	3	8	14	16	43	9	14	18	23	21	20
4. Grind the wheat	12	0	3	5	4	24	2	3	7	20	4	8
5. Mix flour, milk, and other common bread ingredients	28	1	6	9	12	37	7	10	11		13	15
6. Bake	28	3	7	8	10	23	5	10	13	23	14	14
7. Use a bread maker or other machine	9	1	1	3	4	19	6	0	3	NL	4	5
8. Gives a good explanation that includes making and then baking dough	21	1	4	6	10	33	5	7	9		8	13
21A. Where does the meat in a hamburger come from?												
0. Doesn't know/no relevant response	39	19	11	7	2	-53	14	15	10		19	20
1. Animals other than cows	18	1	6	6	5		4	4	10	23	12	6
2. Cows	39	4	7	11	17	41	14	13	12		17	22
21B. What is the process of making the hamburger patty?												
0. Doesn't know/no relevant response	36	17	10	9	0	-52	12	13	11		19	17
1. Kill the animal	34	1	7	10	16	47	12	11	11		18	16

Table 1 (cont'd.)

2. Cut up the animal or take the meat off of it	34	3	6	10	15	39	10	11	13		16	18		
5. Fry, grill, cook the meat	26	7	6	10	3		7	7	12		11	15		
6. Shape the meat into patties	10	0	2	0	8	45	5	2	3		5	5		
22. Why do some farmers raise chickens?														
0. Doesn't know/no relevant response	7	4	2	1	0	-24	5	1	1	-23	1	6	20	
1. To eat them or get chicken meat	62	15	14	16	17		18	21	23		34	28		
2. For the eggs	50	7	14	14	15	27	15	16	19		25	25		
3. To get baby chickens	9	1	4	1	3		4	2	3		4	5		
4. To sell them to stores	13	0	1	4	8	38	6	1	6		7	6		
23. Some farmers raise cows. What do we get from cows?														
1. Milk	87	22	22	24	19		28	30	29		44	43		
2. Other diary products (butter, cheese, ice cream etc.)	12	0	1	6	5	32	4	3	5		4	8		
3. Meat (hamburger, steak beef, etc.)	49	8	9	13	19	36	13	19	17		25	24		

Table 1 (cont'd.)

24. Some farmers raise pigs. What do we get from pigs?

0. Doesn't know/no relevant response	20	8	4	6	2	-23	10	8	2	-26	8	12
1. Mud	6	4	2	0	0	-29	2	2	2		4	2
2. Meat	37	10	9	8	10		12	12	13		21	16
3. Bacon	21	2	4	5	10	30	4	7	10	19	9	12
4. Ham	27	2	6	10	9	29	7	10	10		11	16
5. Pork, pork chops	13	0	3	2	8	36	4	2	7		6	7
6. Sausages, hot dogs	9	2	0	3	4		2	4	3		4	5
7. Mentions specific pork product (coded in 3, 4, 5, or 6)	51	5	12	14	20	45	12	16	23	28	23	28

25. Some farmers raise sheep. What do we get from sheep?

0. Doesn't know/no relevant response	26	14	7	3	2	-44	10	12	4	-24	14	12
1. Meat	23	1	5	7	10	32	7	4	12	NL	11	12
2. Fur, fuzz, fluff, hair	8	2	3	2	1		2	2	4		2	6
3. Wool	22	3	6	5	8		6	9	7		11	11
4. Clothing, mittens, blankets, wool fabric	39	5	9	13	12	26	14	9	16		20	19

Table 1 (cont'd.)

26. A pound of cereal costs more than a pound of apples. Why is that?

0. Doesn't know/no relevant response	38	16	11	6	5	-37	15	13	10		17	21
1. You get more cereal: bigger box, lasts longer	43	8	10	14	11		10	16	17	19	23	20
2. Cereal is better for you than apples	7	0	0	2	5	33	2	0	5	NL	5	2
3. Cereal has additional or more expensive stuff in it: sugar, marshmallows, honey, food coloring, toys in the box, the box itself	15	2	5	4	4		7	5	3		9	6
4. Cereal needs to be manufactured but apples can be picked	8	0	0	3	5	32	1	2	5	19	3	5

27. It costs more to eat a meal in a restaurant than it does to have the same meal at home. Why is that?

0. Doesn't know/no relevant response	31	19	8	3	1	-62	13	9	9		15	16
1. You have to pay for food at a restaurant, but at home it's free (used only if 4 or 5 are not coded)	22	2	11	5	4	NL	9	10	3	-23	9	13
2. Restaurants offer better food or greater selection of food	12	3	2	3	4		4	4	4		8	4

Table 1 (cont'd.)

3. Restaurants are special, fancy places to eat out	7	0	0	1	6	40	3	3	1		3	4		
4. You pay people for cooking and serving the food	34	1	3	13	17	58	7	9	18	31	19	15		
5. The people at the restaurant have already bought the food and you have to reimburse that	8	1	0	2	5	28	3	0	5	NL	4	4		
28. What are the steps that farmers go through to grow corn?														
0. Doesn't know/no relevant response	7	4	2	1	0	-24	3	3	1		1	6	20	
1. Plant the seeds	85	17	22	23	23	33	26	28	31	20	46	39	-23	
2. Weed, rake, hoe the soil	11	2	2	3	4		3	3	5		7	4		
3. Water the plants	63	15	18	16	14		24	21	18		33	30		
4. Wait for the plants to grow enough	72	13	17	20	22	33	23	24	25		37	35		
5. Pick, cut, or harvest the corn	65	12	14	18	21	31	19	22	24		31	34		
6. Shuck or clean the corn	18	6	4	3	5		8	3	7		9	9		
7. Make sure the corn gets enough sunshine	12	2	2	5	3		5	3	4		5	7		

Table 1 (cont'd.)

8. Fertilize the corn or spray pesticides	7	1	0	2	4	24	2	3	2		4	3			
9. After harvest, clear the field/plow for next planting	9	0	0	4	5	33	2	1	6	23	1	8	25		

29. There are lots of farmers around here but there are not so many farmers in Alaska. Why not?

0. Doesn't know/no relevant response	39	19	12	7	1	-56	18	11	10	-23	19	20			
1. Not as many people live in Alaska	10	3	5	1	1		5	3	2		5	5			
4. It is too cold/snowy in Alaska (unexplained further)	18	1	2	7	8	33	4	8	6		9	9			
5. It is too cold/snowy to grow crops in Alaska	26	1	4	7	14	45	4	9	13	26	13	13			
6. It is too cold for animals to survive in Alaska	7	0	1	1	5	31	3	2	2		2	5			
7. There is not enough sunlight in Alaska	7	0	0	2	5	33	0	3	4	20	3	4			

30. How is farming today different from farming 100 years ago?

0. Doesn't know/no relevant response	45	22	13	6	4	-59	16	16	13		20	25			

Table 1 (cont'd.)

4. They didn't have the range or quality of animals/plants/seeds we have now	7	0	3	2	2		2	2	3	7	0	-28
5. We have better tools (nonmechanized hand tools)	8	0	1	5	2	28	3	2	3	3	5	
6. We have machines (tractors and other large machines)	29	0	4	11	14	50	8	10	11	15	14	
7. Farming is easier now/ harder then (not explained or explained without referral to machines)	7	0	3	3	1		3	2	2	4	3	
31. What are some inventions that have helped farmers?												
0. Don't know/no relevant response	29	20	4	3	2	-67	10	10	9	11	18	
2. Horses, cows, or other animals	7	1	2	2	2		3	2	2	5	2	
3. Hand tools: pitchforks, rakes, shovels, hoes, etc.	17	2	7	3	5		7	6	4	10	7	
4. Generic machines or motors	15	1	4	6	4		7	3	5	7	8	
5. Tractors	37	0	10	14	13	47	10	15	12	23	14	-19

Table 1 (cont'd.

6. Farm machines besides tractors (tillers, combines, etc.)	27	0	5	11	11	43	7	7	13	20	12	15	

32. Long ago, most people had to be farmers in order to produce enough food to feed everyone. But today, only a few farmers produce all the food we need. Why is that?

0. Doesn't know/no relevant response	60	24	20	12	4	-66	21	21	18		26	34	17
3. Farmers have more knowledge now	7	0	2	2	3		3	2	2		6	1	-20
4. Farms are bigger now/ have more land/have more animals	17	0	3	5	9	36	4	4	9	19	9	8	
5. Farmers have better equipment now (tractors, etc.)	22	0	0	7	15	61	5	8	9		12	10	
6. Machines allow a person to get more done in the same time	14	0	0	7	7	41	4	3	7		8	6	

[1]Numbers in the frequencies columns show how many students in each group were coded for mentioning the ideas represented by the response category described at the left side of the table. Underlining indicates that the Chi-square for the underlined distribution was statistically significant at or below the .05 level. In these instances the phi coefficients (with decimal points omitted) are given in the phi columns (where significant linear trends were indicated) or else the letters "NL" appear to indicate that the relationship was nonlinear.